THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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EFFICIENCY IN INDUSTRY.

INDUSTRIAL unrest, as we have pointed out in these columns more than once, arises from a multitude of causes. Nothing could be more foolish, then, than to act as if it were the consequence of one cause only; and the advocacy of one specific remedy as the certain cure for the disease, when it can, at best, merely allay one or two troublesome symptoms, must lead but to its aggravation.

Industry depends upon trade. A product cannot be manufactured unless it has first been sold, and the fact of a sale presupposes the existence of a buyer. Markets do not spring up by themselves, but have to be discovered and built up. A market may exist in a potential form, for there was a use to which the plough could be put ages before prehistoric man discovered that plants grew from seeds; but before an article can be sold, there must be a prospective use for it, a prospective user of it, and the wherewithal to pay for it, either at once or at some future time. Thus, in spite of the superficial and inaccurate thinking of some modern economists, there is a real need for the trader; and since the place of use is seldom the best place for manufacture, there is need for the transporter too.

Reasoning in this way, it is not difficult to build up the whole complex fabric of modern life, or rather, to see how it has been built up during the course of ages. Everything has arisen as a result of the two primary needs, or instincts—self-preservation and reproduction.

Since industry depends upon trade, and one essential of trading is something to pay with, the financier is evolved. He depends, for the funds with which his business is done, upon savings, that is to say, upon the practice of economy. Those who save and invest their savings are not only providing for themselves, but are making it possible for others to support themselves.

Unemployment is the result of depression in manufacturing industries. There are limits to the possibilities of manufacturing for stock, especially during a period of falling prices, and in most cases these limits have been reached, if not passed, long since. If manufacturing industries are to be revived, orders for goods have got to be obtained, so that energetic selling is one of the first essentials. Next, since this is a country which cannot live without imports, the export market must be properly cultivated, and in the case of the war-impoverished countries, the prospective customers must be rendered able to buy.

The market having been obtained, and being sedulously cultivated all the time, it is necessary to see that the best and most economical methods of production are employed. This does not mean the lowering of wages, or it need not mean that. It does not mean only the abolition of ca' canny and restriction of output. The blame for high costs of production cannot truthfully be laid at the door of the worker only. The limits between which a selling price must lie are, on the one hand, the cost of manufacture, and on the other, the price at which the prospective user will not find the purchase a paying proposition. Electricity cannot be sold at 0.1d. per kWh, for that is below the cost of generation

and distribution; and it cannot be sold at £1 per kWh, because people would use gas, or candles, or go to bed early. So production costs must be as low as possible, and every means that exists of getting and keeping them low must be employed.

This necessitates the use of the best equipment, and it also necessitates the most efficient use of that equipment when installed. This sounds obvious enough, but it is far from being universally the case that a manufacturing plant is used in the best possible manner. It is not a question of machines only, though machines enter largely into it. Feeder departments often do not lead up properly to the assembling department. Different parts of the same apparatus do not synchronise in their arrival, and some are kept waiting about, occupying floor space and preventing its legitimate use, and being exposed at the same time to the possibility of damage. Parts do not assemble properly when they do arrive, and time has to be wasted in the making of adjustments which ought not to be necessary. In electrical apparatus it too often happens that many things are left to be done in the shops which ought to have been properly laid out in the drawing office. This not only wastes time in the first place, but may lead to breakdown on test, and to unnecessary trouble perhaps years after, if repairs are required.

All these are points for which, not the worker, but the management and the staff are responsible. They all add to the cost, and consequently to the difficulty of selling the product. In those cases in which selling prices are regulated by groups of manufacturers, the price level arrived at should be that at which one can afford to sell and should have a definite relation to the cost of production. The fixing of prices for munitions on a basis of the production costs of the worst-equipped factory in a district cost the country countless millions during the war.

Many ways in which manufacturing efficiency can be improved are dealt with in a useful little book by Mr. J. E. Powell, entitled "The Output Problem."* It appears, from Mr. Powell's experience, that it is no uncommon thing for a manufacturer not to have any approach to an accurate notion as to the output of which his plant is capable. Indeed, he goes so far as to say that the existence of the premium system of payment by results may be regarded as an admission of inability to estimate the possible output—but we anticipate. We consider that he amply proves the case for the existence of a Progress Department, whose duty it shall be to co-ordinate effort and remove causes of delay between departments and between sections.

Manufacturing processes must be the subject of careful thought by men trained for the work. A great deal too much is left to foremen, who already have enough to do in arranging the work of the operatives. There are very few foremen in engineering works who will not get a job done. They will make an attempt at it, and generally the result will be satisfactory, but it is far from probable that it has been accomplished in the most efficient way. The planning of the work must be done in the office and possible difficulties must be anticipated. Shop experience, of course, needs to be duly taken into consideration, and with a combination of skilful planning and practical knowledge, the best methods of carrying out the work ought to be capable of being evolved. The capacity of machines and tools of modern design must necessarily, if the proper research has been carried out, be better known in the office than in the shop which is about to make its first use of them, and plant must be worked at its best efficiency. It does not pay to take care of the machines at the expense of a reduced output.

The question of the reward of industry has an important bearing upon the subject of efficiency, but we must reserve consideration of this for another occasion.

* "The Output Problem." By J. E. Powell. London: The Library Press, Ltd. Pp. x+168. 6s. net. (The Manufacturing Problem Series, edited by Edward T. Elbourne.)

High-Pressure Transmission.

An article published in *The Times Trade Supplement* recently brought together some interesting data with regard to the development of power transmission over great distances at very high pressures in the United States, showing how the success of the 240-mile Big Creek line from the hydro-electric stations in the mountains to Los Angeles, working at 150,000 volts, led to the construction of a 186-mile line to San Francisco working at 165,000 volts, and this again was followed by the adoption of a pressure of 220,000 volts for a line 200 miles long from Pit River to San Francisco, to carry 120,000 kW, with a loss in transmission of only 7 per cent.

The cost of these remarkable installations per kilowatt and per mile decreases as the pressure is increased, though not in the same proportion; the carrying capacity increases as the square of the pressure, while the cost is roughly in proportion to the pressure. Hence raising the pressure is economically sound practice, provided that the saving is not off-set by additional cost of maintenance, which condition appears to be fulfilled. It is not surprising, therefore, that a further step is in contemplation—namely, the conversion of the Big Creek line from 150,000 to 232,000 volts—for which purpose an experimental line has been put in operation at the latter pressure. This process will double the carrying capacity of the line, which is at present 130,000 h.p. The change is necessary because it is proposed ultimately to transmit 1,000,000 h.p. to Los Angeles from the Big Creek water-power development, and the adoption of the higher pressure implies a saving estimated at seven millions sterling as compared with the lower, the whole outlay on the undertaking being estimated at no less than 40 millions. The copper cables alone, nearly one inch in diameter, for the Pit River line weighed 11,000,000 lb., the largest order of the kind on record, and cost about £1,800,000; the total cost of the line was about £7,000,000.

Such enormous undertakings are possible only in a country blessed with almost inexhaustible natural water-powers. In this country it is held to be cheaper to transport coal than to transmit energy over great distances, and unless tidal powers are developed, the opportunity of carrying out such magnificent schemes will not fall to the lot of our engineers at home; but the Empire possesses water-powers fully comparable with those of the Pacific Coast of North America, and when the occasion arises to make use of them, we have no doubt that British engineers will prove to the world that they can cope with the problem successfully. Already transformers and switchgear for a line pressure of 110,000 volts are being built in England, and it is interesting to note that a British insulator is being tried out on the Big Creek experimental line, with results said to be very encouraging.

On this side of the Atlantic the most progressive people appear to be the French, who handle 45,000 volts without diffidence, even on somewhat make-shift apparatus, as will be gathered from some of the illustrations accompanying our report of the Electrical Review French Tour. The highest pressure they have as yet put in operation is 120,000 volts, on the line from the Basse-Isère to Saint Etienne.

German Export Orders.

The directors of an electrical manufacturing company at Aix-la-Chapelle state that a considerable falling-off in export orders has taken place in recent months, as well as in orders for home accounts. Yet, according to the experience hitherto gained in the export trade, the further extraordinary depreciation of the mark should have led to an increase in the foreign orders. It is assumed that as the contrary result has taken place, other countries are apprehensive of an economic collapse of Germany, and under these circumstances and despite the favourable opportunity afforded by the fall in the mark, they are not disposed to place orders on a large scale on the usual condition of making large payments to Germany in advance.

THE "ELECTRICAL REVIEW" FRENCH TOUR.

(*Continued from page* 582.)

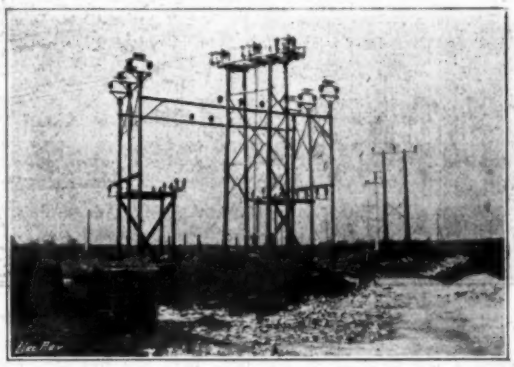
The (temporary) sub-station at St. Nicholas is a brick building with a slate roof, and contains two 2,500-kVA transformers, stepping down from 45,000 volts to 15,000 volts, at 50 cycles; these are water-cooled, with the aid of a cooling tower close by, the circulating pumps being situated inside the building and driven by motors. The switchgear is mounted on an open iron framework, and shielded with wire screens; only the disconnecting switches are indoors, horn-break switches being mounted on a gantry in the open air, as shown in an accompanying illustration. Lightning arresters of the multi-cylinder type are provided, with water resistances and horn gaps. The practice is to open-circuit the low-pressure side of the transformers before opening the high-pressure air-break switches. This sub-station and a similar one are "reconstruction" jobs, and have worked perfectly well for 18 months; the permanent sub-stations which will replace them will be equipped with oil switches. Eventually the pressure will be raised to 80,000 volts; when this is done, there will be no water in the sub-station, the transformers being oil-cooled.

The incoming mains enter the station through holes in glass plates; the busbars are of copper rod on insulators. In addition to the 45,000- and 15,000-volt circuits, switchgear is provided for 5,000 volts.

Supply is given to the sub-station from Neuilly-les-Mines, Béthune, or Bully, and from it to other sub-stations; there are some 300 transformer posts on the system. The engineer responsible for the work was M. Carrière, who explained the arrangement of the plant, and accompanied the party to Béthune.

The overhead mains are carried on glass insulators as far as possible; the poles are of lattice steel or reinforced concrete, and sometimes of wood. Generally a rectangular iron frame surrounds the conductors at each pole, to guard against falling wires.

Leaving St. Nicholas, the procession of cars took the road to Lens, passing through war-scarred country. In a few miles the Labyrinth was reached, a region so named from the complexity of the trenches; the ground has remained untouched since the war, and the chalk has been so thoroughly churned up with the soil that the land is believed to be useless for agricultural purposes.

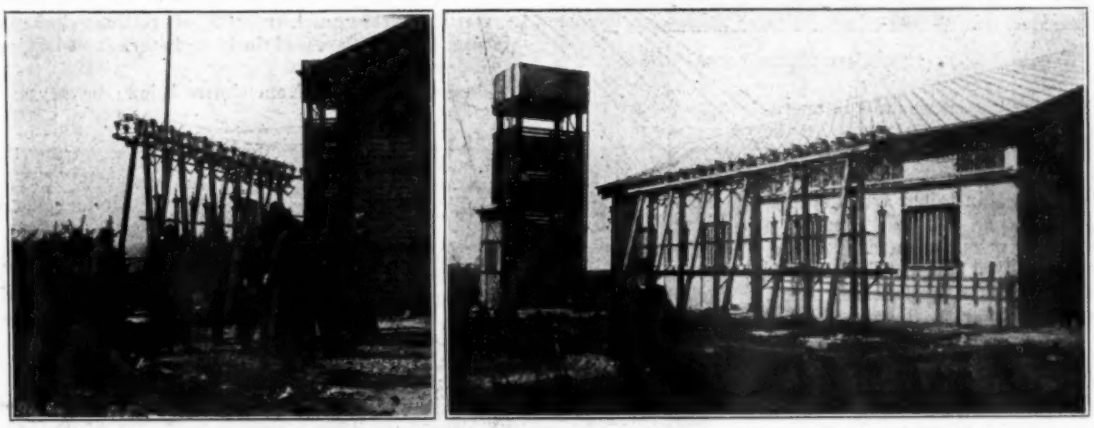


Open-air Switchgear for 45,000 Volts.

On the Road to Bethune.

After passing the site where once was the village of Thelus, a memorial to the men of the Canadian Artillery who fell at Vimy in April, 1917, was seen; the route lay along the top of the Vimy Ridge, and on the descent towards Lens many concrete and steel "pill-boxes" were noticed. Near Loos a stop was made to inspect the great mine crater, which is preserved in its original condition by the French Government. Lunch was taken at the Hotel des Gobélins, Béthune, the only place in the district where it was possible to feed so large a party, and afterwards a visit was paid to the power station of the Compagnie des Mines de Vicoigne, Nœux, et Drocourt at Beuvry, which had already been sighted on the way to Béthune.

This power station was planned in 1918, before the end of the war, to supply electricity to the company's coal mines at Nœux, and to a number of subsidiary electrical companies; the first orders were placed on May 24th, 1919, and shortly afterwards further developments led the company to order plant up to about 40,000 kW, which will be in commission within a few months, this



Open-air Switchgear for 15,000 Volts, and Cooling Tower for Circulating Water, at St. Nicholas Sub-station.

representing half the ultimate capacity for which the station is designed.

The installation comprises a boiler-house at right angles to an engine-room containing two 6,000-kW and two 10,000-kW turbo-alternators, a switchhouse, and a sub-station containing transformers which raise the pressure to 15,000 V on eight underground feeders and to 45,000 V on six overhead feeders. Cooling towers and water purifiers are provided. Two generating sets of 20,000 kW each will ultimately be installed in the existing engine-room, and the boiler-house will be duplicated. The engine room is served by a 40-ton electric travelling crane. In addition to two 15,000/200-V transformers for the auxiliary apparatus, two 5,000/15,000-V transformers are installed of 7,500 kVA and three of 12,500 kVA. Three 5,000-kVA, 15,000/45,000-V transformers are in place. Horn lightning arresters are provided for the 45,000-V feeders, and water-jet pressure limiters for the busbars at both pressures.

A railway line from the Nœux Mines passes the power station, and an ample supply of water is available from shallow wells—the latter being the main reason for choosing this site.

The first sod was turned in August, 1919, and in spite of the scarcity of labour and material, the first generating set was put in operation on August 20th, 1921. All the buildings are of reinforced concrete filled in with brick.

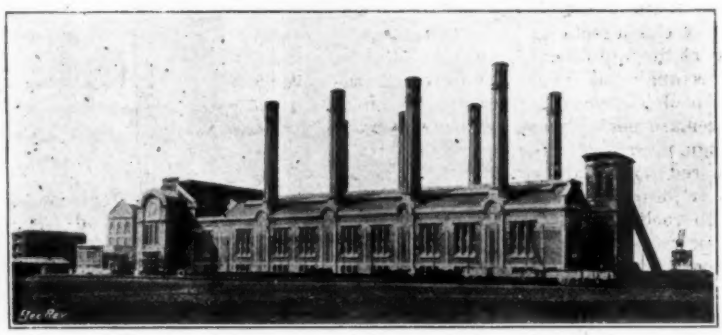
The Party at Beuvry.

The Mine Crater near Loos.

The boilers installed are of special interest, being of the "Kestner" type of Messrs. Schneider & Co. (made in this country by Messrs. Ransomes, Sims & Jefferies, Ltd., sole licensees for the British Empire and many foreign countries). Essentially this boiler consists of two horizontal drums connected by straight vertical water-tubes, amongst which the hot gases from a furnace in front of the boiler pass many times. Each of the 16 boilers has a heating surface of 430 m.², and a grate area of 19.5 m.² (210 sq. ft.). The working pressure is 16 kg. (230 lb.), superheat 350° C., and the normal duty is 10,000 kg. (22,000 lb.) per hour, which can be increased by 20 per cent. if required. Each boiler has 14 sets of tubes, each set consisting of 18 ordinary tubes and four larger tubes containing concentric water-circulating tubes. Green's economisers are used, with 320 cast-iron tubes per boiler. Natural draught is provided by eight chimneys of reinforced concrete, 150 ft. high and 9 ft. in diameter at the top. These stacks are completely detached from the building, though they pass through it; they were built on the Monnoyer system. A forced-draught fan driven by a 22-h.p. motor is installed with each boiler. The fuel used (washery refuse) often contains 30 to 35 per cent. of ash, 13 to 14 per cent. of volatiles, and a fairly high proportion of water, so that special precautions have had to be taken to ensure the descent of the coal into the hoppers of the mechanical stokers, the passages being made as direct as possible, the sides of the chutes at a steep angle, and their capacity reduced to 5 tons per boiler, to prevent choking, with the incidental result that the firing floor is exceptionally well lighted, as our illustration shows. The low calorific value of the fuel has further necessitated a large grate area, the ratio to the heating surface of the boilers being 1:22.

The fuel is discharged from 20-ton railway trucks into a sunk hopper of 40 tons capacity, from which two belt conveyers are fed; these bring the fuel to two bucket conveyers which raise it to a bunker of 50 tons capacity at the end of the boiler house, from which again scraper conveyers take it to the boiler chutes. Storage tanks are to be provided alongside of the coal siding, to facilitate the quick release of rolling stock, the mixture of four classes of fuel, and storage to last over a two-days' holiday.

Ashes are removed from chutes below the grates by skips travelling on a runway, driven at 20 m. per minute by an endless rope; the skips are run on switches under the ash-chutes, filled, and returned to the runway, when they are automatically run out to an automatic hoist which deposits the ashes in a hopper over the railway.



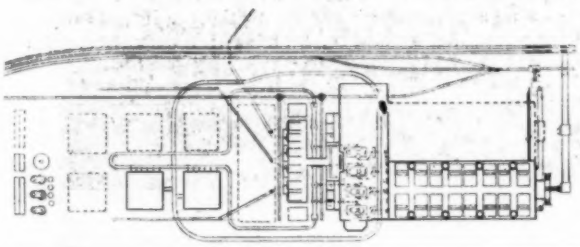
Beuvry Power Station.

The pump room, 275 ft. long and 33 ft. wide, between

the end of the boiler-house and the engine-room, contains, besides the feed and condenser pumps, three well pumps each capable of raising 100 tons of water per hour, the bore-holes being 2 ft. in diameter and 150 ft. deep. The well pumps are driven by vertical-shaft motors of 33 h.p. each.

Two 50-ton tanks receive the water of condensation and the drains from steam separators, and the exhaust from two small turbines which drive feed pumps—in all about 95 per cent. of the water evaporated. All the feed pumps are of the centrifugal type, two driven by steam turbines and two by 150-h.p. induction motors at 5,000 V, 2,800 r.p.m. Half these pumps are sufficient for all the boilers.

The engine-room is 275 ft. long and 66 ft. wide, and can accommodate six generating sets, of which four are installed. The turbines are of the Zoelly type, built by Messrs. Schneider & Cie., and run at 3,000 r.p.m.; the 6,000-kW and 10,000-kW alternators generate at 5,250 volts, 50 cycles, three-phase. The condensers have cooling surfaces of 8,600 and 12,900 sq. ft. respectively, and



Plan of Beuvry Power Station.

the circulation water is 1,840 and 3,150 tons per hour, the pumps being driven by motors of 137 and 250 h.p. Two motor-generators are installed, each consisting of a 5,250-V motor, a 250-kW d.c. generator working at 220 volts, and a reserve exciter of 40 kW at 120 V, the set running at 1,450 r.p.m.

The guaranteed steam consumption of the 6,000-kW sets at 4,800 kW (p.f. unity) is 13 lb. per kWh, with steam at 200 lb. and 320° C. superheat. The 10,000-kW sets under similar conditions at their economical load of 8,000 kW take 12 lb., including the steam consumed by the pumping sets. An Alba meter for the condensation water is provided for each turbine. The air-filters are of the Sturtevant wet type.

The condenser pumps are normally driven by a steam turbine through gearing, exhausting into a stage of the main turbine or to atmosphere according to the load. Provision is made for quickly uncoupling the pump turbine and driving the pump by a stand-by motor.

The main steam pipe is 13½ in. in diameter, and forms a closed rectangle. The long legs of this ring are fixed at the middle of their length, and at the angles of the rectangle ball joints are provided, the invention of M. Luc-Denis, which allow free expansion of the ranges, but remain perfectly steam-tight with superheated steam at high pressure. The eight boilers farthest from the anchored points are connected to the steam range by similar joints.

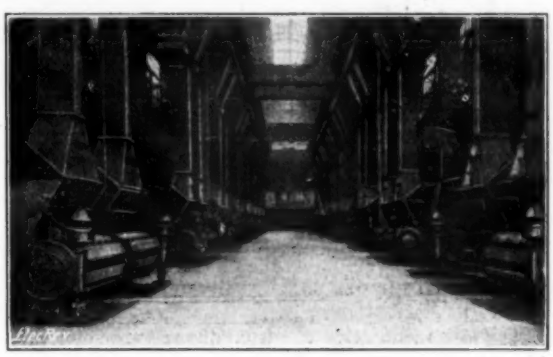
Two cooling towers are in operation, and two more will be required, with a fifth as stand-by, when the station is completed. Each can deal with 370 tons per hour, and covers an area 80 ft. square, with a height of 50 ft. The towers are constructed of reinforced concrete, filled in with brick, and the reservoirs are also of ferro-concrete, as well as the columns which carry the baffles, and the distributing tank; the baffles are of creosoted wood. The cold water duct is underground, of reinforced concrete, and forms a ring; the hot water is pumped up into an aqueduct extending the whole length of the engine-room, from the ends of which steel pipes strengthened with ferro-concrete carry the water underground to the coolers, again forming a ring. Owing to the great length of the aqueduct, two expansion joints are provided.

The well water being very hard, three purifiers are installed, and three more will be required for the completed station, having an output of 50 tons per hour each. The water is pumped into one of two concentric tanks on a water tower, holding 100 tons, the other tank holding 300 tons of softened water. From the tank the hard water gravitates to the purifiers, and after treatment it is filtered before passing to the cold water duct or to the water tower.

The switchhouse, adjoining the engine-room, is 196 ft. long and 25 ft. wide. The main circuit breakers for the alternators and the auxiliary services at 5,000 volts, with a set of bus-bars, are housed in the lower part of the switchhouse. Each alternator is provided with a transformer of the same capacity, and paralleling is done on the 15,000-V side, though the main breakers are between the alternators and the corresponding transformers. The 5,000-V busbars, however, enable an alternator to be coupled to a transformer other than that normally used with it. The sub-station building is separated from the switchhouse by a space 40 ft. wide, and contains on the ground floor four sets of busbars at 15,000 volts, which can be sectioned at the middle. On the same floor are the paralleling and feeder circuit breakers at 15,000 and 45,000 volts; above these are two sets of busbars at 45,000 volts, and the lightning arresters are on the second storey. Three 5,000-kVA transformers stepping-up from 15,000 to 45,000 volts are installed in the sub-station. Railways provide for the removal of all the transformers to a repair shop. At either end of the sub-station there is a separate building in which the transformer oil is cooled.

The general contractors for the power station were Messrs. A. Legrand and P. Munich, of Paris.

The visitors were received and conducted over the station by the managing director, M. Barthélemy, and M. Meunier, the station superintendent, and at the close of the visit Major Rich, in a brief address, expressed the gratitude of the party for permission to see these interesting works, which had been erected in so short a time since the war. M. Barthélemy, in response, said that the local residents were well aware that the British Army prevented the Germans from reaching that spot, and the many British cemeteries in the neigh-



Interior of Boiler-house, Beuvry.

bourhood bore witness to the gallantry of the British soldiers; the people would never forget what the British had done for them.

Special interest was shown by members of the party in the system adopted for communication with the sub-stations by a mode of "guided wireless" telephony, the messages being sent into lines paralleling the 45,000-V overhead mains for a short distance, and received on similar conductors at the sub-stations. Concerning this system, and the Kestner boilers, we hope to publish details in an early issue.

From this station power is transmitted as far as Calais. Ten pits are supplied at 15,000 volts, and one at 45,000 volts, and the system is interlinked with the State transmission lines.

(To be concluded.)

THE DERBY ELECTRICITY UNDERTAKING.

Inauguration of New Plant.

The Derby Corporation obtained its provisional order to supply electricity in 1890, and the works were opened in 1894, the plant consisting of three Lancashire boilers and six single-phase 100-h.p. alternators. Mr. T. P. Wilmshurst, to whose energy the development of this concern are mainly due, took charge in 1898, and the first increase in the plant was made in 1896 when two reciprocating engines of 250 h.p. each were installed. These were followed by the erection of a 1,000-h.p. engine and alternator, built by Messrs. Ferranti, Ltd.

The Derby electric tramway system was opened in July, 1904, and in order to supply the current the existing electricity works were greatly enlarged. It was determined to provide direct current as well as alternating, and four Parsons turbine generators were introduced. The single-phase alternating system was considerably augmented by the erection of two more 1,000-h.p. Ferranti engines and alternators, and by the substitution of water-tube boilers with mechanical feeding and chain-grate stokers.

The demands for electric power having grown, the committee in 1907 advised the Council to erect an up-to-date station. It was designed by Mr. Wilmshurst and opened in April, 1908.

The new installation consisted of two turbo-generators of 750 kW capacity. Shortly afterwards another turbine was erected. In January, 1913, Mr. Wilmshurst advocated the laying down of much larger plant than had previously been employed, and the Council installed a 2,000-kW turbo-generator by Messrs. Parsons & Co. of the three-phase alternating-current type. Again in 1914 and 1917 the committee asked for two more such turbo-generators. The Government diverted a set which was being built for South Africa of 4,000 kW, and in February, 1920, the committee determined to complete the works, and to install a much larger turbo-alternator and two large boilers with all their auxiliaries. The total estimated cost was £120,000.

Messrs. C. A. Parsons & Co., Ltd., of Newcastle, again secured the contract for the turbine, alternator, and condensing plant; the whole of the turbine plant in the new station was supplied by the same firm.

The site of the station is central, and although the coal sidings are a short distance from the works, the method of bringing coal into the boiler-house by means of four 5-ton electric lorries, with the recent installation of coal-handling plant at the Corporation's own sidings, is a very economical arrangement. From the point where the coal is received up to the removal of the ashes, the whole operation is, as far as possible, automatic. The coal is automatically weighed, falls by gravity on to the revolving grates, the ashes fall into a tunnel underneath, and are then conveyed to the ash elevator. The whole of the coal and ash-handling plant was supplied by the Ewart Chainbelt Co., with Messrs. Handyside and Messrs. Eastwood Swingler, of Derby, as sub-contractors.

There are at present eleven water-tube boilers, complete with Green economisers, induced-draught plant, &c., each boiler evaporating 25,000 lb. of water per hour at a pressure of 180 lb. to the sq. in., the whole being supplied by Messrs. Babcock & Wilcox, Ltd. The feed water is pumped into the boilers by three electrically-driven Rees-Roturbo centrifugal pumps, running at 2,000 r.p.m., each of a capacity of 10,000 gallons per hour, and by two steam Weir "Roto" feed pumps.

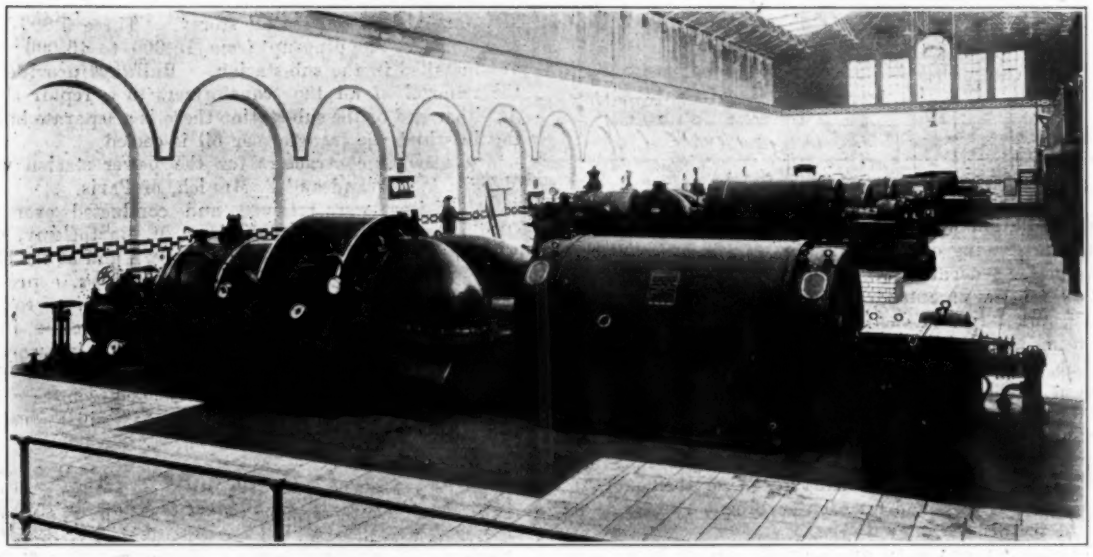


Fig. 1.—Turbine Room, Showing New Parsons Set in Foreground.

The old engine room is now used as a distributing station, and the only running plant consists of rotary converters and motor alternators. Water for condensing purposes is drawn from the river. Adjoining the river are the automatic water-softening plant and revolving screens.

The turbine room contains the following plant:—

Three d.c. turbo-generators, each of 750 kW, running at 1,800 r.p.m.

Three three-phase, a.c., 6,600-volt turbo-generators, each of 2,000 kW, running at 3,000 r.pm.

One three-phase, a.c., 6,600-volt turbo-generator of 4,000 kW capacity, running at 3,000 r.p.m.

The latest addition consists of a three-phase turbo-alternator of 7,500 kW capacity, running at a speed of 3,000 r.p.m., fig. 1.

The condensing plant, fig. 2, is in the basement directly underneath the turbine, has a cooling surface of 9,500 sq. ft., and is designed to deal with 72,000 lb. of steam per hour. It is supplied with cooling water by a motor-driven pump, developing 195 h.p., and delivering 500,000 gallons of water per hour. The pump is housed on the old Silk Mill Island, and draws water from the

main river, through a 13 ft. 6 in. diameter revolving screen by Messrs. Brackett & Co.

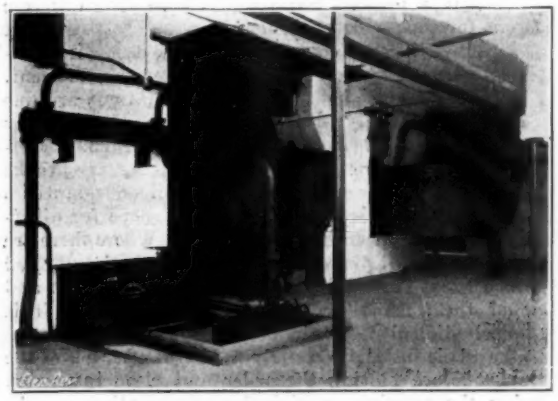


Fig. 2.—Condensing Plant.

A Heenan & Froude fan supplies air for cooling the alternator, which is drawn through a wet air filter.

The turbine room, therefore, contains plant of 19,750 kW, or 26,500 h.p.

The switchgear is placed on a main gallery, and was chiefly supplied by the British Thomson-Houston Co., Ltd., of Rugby.

During the year 1921-22 the number of kWh generated was 15,878,346, with a coal consumption of 3.01 lb. per kWh (the coal consumption to date, 1922-23, approximates 2.75 lb. per kWh), and besides railways and collieries, the station supplies electricity to 266 different industries in the district. Owing to the trade depression, the sale of energy dropped in 1921-22 over 3 million kWh, but the current year is promising to be a record one.

On October 27th the Mayor (Councillor W. R. Raynes) started the plant which has just been installed.

The chairman of the Electricity Committee (Ald. W. G. Wilkins) mentioned that Derby now produced as much electricity as Leicester or Nottingham, notwithstanding the fact that it was only about half the size of those towns. As regarded coal consumption, Derby led the way amongst the towns for a radius of 30 or 40 miles. The general public had to thank the electricity department for its influence on the health of the people, and with 270 industries being driven by electricity, there were so many fewer smoky chimneys in Derby; and the smoke having been got rid of, buildings and vegetation had not suffered as they might have done. He believed there was a very encouraging outlook for the undertaking.

ELECTRO-FARMING.—I.

Introductory Article.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

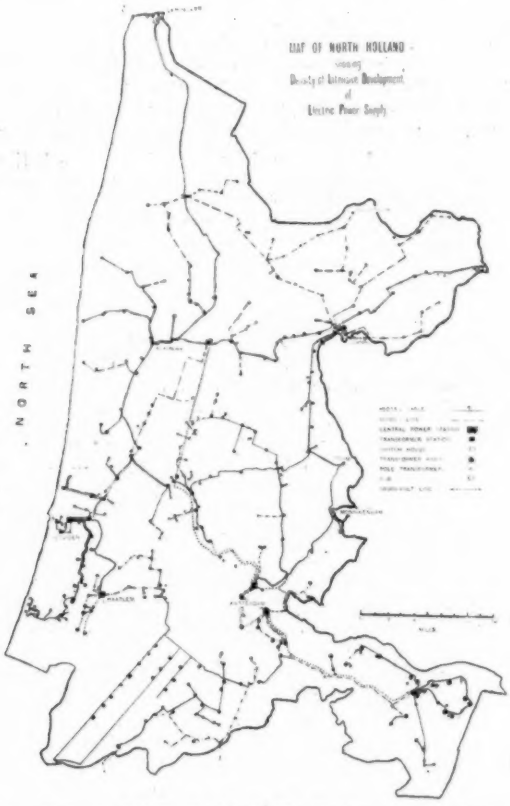
British electrical engineers do not seem to have as much faith as British farmers in the development of electrical applications to agriculture. Sufficient precedent for this new departure is to be found, however, on the Continent. Moreover, even in this country there are already a number of practical examples. This article is the first of a series which will endeavour to elucidate the problems that have arisen by means of a systematic investigation of the whole field. A preliminary survey was given in the early part of this year by the present author in a paper before the Institution of Electrical Engineers (see Electrical Review, April 7th and 14th, 1922). In these notes it is proposed to amplify the references given in the paper, and more particularly to bring the subject up to date.

On the Continent for some years past the greater part of the output of electric motor-building factories has been for agricultural purposes. In one week last June a German manufacturer turned out 160 electric ploughing sets—of course, it is highly probable that this was a special effort, that deliveries had been delayed for a few weeks previously, and that none were sent out for a few weeks afterwards. Still, the output of electric ploughs in England—the pre-eminent manufacturing country for steam, tractor, and horse ploughs—so far is nil, as nothing yet seems to have passed the drawing-board stage. In fact, British agricultural engineers look rather with disdain at the idea of farmers ever using electricity for such purposes (apparently they have not themselves visited the Continent). Probably every reader of this article has visited an agricultural show at some time or other. They will, therefore, be well acquainted with the fact that the machinery on show is driven by a seemingly uncountable number of small popping and coughing oil engines. At the recent Cambridge Show of the Royal Agricultural Society of England, not so much as a sixteen candle-power lamp was supplied with current by the local electricity supply undertaking. A short time ago the writer made a special trip to view Germany's largest annual agricultural show, which was held this year at Nuremberg. Every machine that was shown in motion was driven by an electric motor. A rough calculation indicated that nearly 2,000 electric motors were employed in this way. Oil engines were shown, but they were relegated to the makers' own stands. Of course, the German farmer's mental attitude to-day, at the sight of an agricultural machine driven by an oil engine, would be that the machine was probably as out-of-date as the engine which drove it. Hence the exhibitor would prefer to steer clear of oil-engine drives, even if offered for nothing. In this connection it is of interest to note the agrarian post-war policy of the Germans. After careful deliberations by all the interests concerned, it was decided that to bring German agriculture into the first rank it was essential to farm more intensively, and also to employ electricity more extensively. As regards the former, the German farmer already farms so intensively and employs so much artificial manure that it would seem hardly possible to do more. With reference to the question of electricity supply, great progress has been made, to the writer's own personal knowledge, for he has visited the farming districts recently and also a year ago. There is now hardly a group of farms that is not connected up. It is no wonder that the Germans have no money for such futile things as reparations when they are expending so many millions on themselves. With the true paternal ways of the German Government, the indication is that if a farmer does not see his way clear to use electricity on his farm, he is at liberty to farm elsewhere, for his farm will be wanted for a farmer who will use it.

Before the war considerable use was made of electricity on Continental farms. During the war, owing to the shortage of oil and coal, the non-belligerent countries made wonderful progress in this direction. Until to-day, in flat countries, such as Denmark and Holland (with many more days of suitable wind than in this country), the electric motor is actually displacing the windmills, notwithstanding the fact that capital is already invested in the latter. The main reason is, of course, that modern commercial requirements necessitate a continuous supply of power. It does not do nowadays to await the vagaries of the weather, and especially as

power is often required for pumping in these countries. Now pumping is most often required in wet weather, and in wet weather, as is well known, there is little wind.

In California well over 600,000 h.p. in motors is already installed on farms. In Great Britain a start has been made in some of the power supply areas, more particularly in the neighbourhood of Hereford, Inverness, and Fife. It is quite a common practice on the part of a colliery company which owns farms for the supply of fodder for its pit ponies, to employ electric power on the farms. The writer is electrically operating his own farm of 600 acres, near East Grinstead, but the field work is still in the experimental stage. Hay has been cured (not merely dried) this year on a full-size scale of three big ricks, by the aid of an electrically-driven Sirocco fan (see Electrical Review, August 25th, 1922, p. 287). Corn has also been matured and dried. Again, corn has been reaped by means of an



Plan of the existing electrical distribution to the farms of North Holland, showing how the Continental farmer has electricity brought to his very fields.

electrically-operated binder, and an electric plough is nearly ready to commence operations.

It is not a simple proposition to operate a farm electrically, for very few electrical engineers have studied the subject, which has many peculiarities, not to say prejudices. The idea of most engineers is that it is merely a matter of belting existing standard electric motors to the existing machines. But the experience of Continental manufacturers is such that they all produce special motors for agricultural work, and they would not have gone to this trouble without sufficient reason.

It is hoped that enough has been said in this introductory note to indicate that there is already a big field in the world for electro-farming enterprise, though possibly very little progress has been made so far in England. However, we must not be too insular in our ideas, for what is probably good for the world is also probably good for England. England wants a good share of the work in connection with the supply of the world's demands, so it is hoped that this series of articles will do something to arouse interest and supply some of the necessary data to this end.

ESTIMATES FOR LIGHTING INSTALLATIONS.

By Major J. C. CONNAN.

Considerable interest has recently been shown in the reasons for such wide variations between the prices put forward by different contractors for the same installation as are everywhere met with at the present moment. It appears to be thought that these variations are due to a few causes only, whereas they are very greatly influenced by at least eight, as can be seen by a consideration of the remarks that follow. It can also be seen that even where specifications and bills of quantities are supplied there is still left plenty of scope for difference in price between the final tenders. Where there are so many different types of material required, supplied in such great variety by so many competing firms, and few of them made by the same manufacturer, it is extremely difficult to obtain a consistent quality throughout the whole installation. By a careful selection of the samples before placing the order and rigid inspection during the erection, a high-class installation can be obtained, and no doubt if this procedure were always strictly applied, a much higher quality of estimate would be put forward, and consequently a smaller range of price difference would result.

An estimate for a lighting installation may be prepared on the lines detailed below, though much will depend on the size of the job and the ideas of the engineer running the department. Variations of this method will probably be the rule rather than the exception.

The following are the main steps in the calculation:—

1. *Data Sheet and Plan.*—It is quite useless to endeavour to put forward a competitive price unless reliable data are provided on which to base the estimate. This information should be conveyed to the contractor on a data sheet, and should consist of the dimensions of the area to be lit, conditions of walls and ceiling, construction of walls and ceiling, nature of work carried on in the area, presence of obstructions to free passage of the light, such as cranes, columns, large machines, &c., particulars of supply, any special wishes of the customer, &c. The plan, which should be to scale, should supplement this information and particularly indicate the point of entry for supply.

It is, of course, assumed that all contractors will be provided with similar information, as otherwise the estimates right from the start are not on a comparative basis.

2. *Work Out Sizes.*—By means of the above information, it is possible to fix the intensity of illumination and utilisation efficiency suitable for the class of work and area to be lit and by the aid of these to determine the size and number of lamps to be used. The positions of the individual lamps are then indicated on the plan and are mainly determined by the construction of the building and the type and arrangement of the machinery. The lamp positions being known, they are then grouped into circuits, the circuits grouped to distribution boards, and these in turn grouped to main supply. The current flowing in each circuit, sub-feeder, and main-feeder can now be obtained, and from their lengths, as taken from the plan, and the allowable voltage drop in each section, their sizes may be calculated. The size of the conductors being known, it is now possible to fix the size of conduit, &c.

Very considerable differences in the final estimate may be introduced here. First, in fixing the number and size of the lamps: secondly, in deciding on the manner in which the conductor shall be run; and thirdly, in calculating the size of the conductor.

Standard intensities of illumination for a large variety of trades, and reliable figures for utilisation efficiencies are now available, and unless a contractor chooses a lower figure than the standard in order to obtain a low estimate, there is no reason why all estimates should not be based on practically the same figures. His choice of the size of lamps to employ (and this will also fix the number) may vary from that of others, but is

limited very considerably by the class of work to be done in the area and the standard sizes of lamps available.

The manner in which the conductors shall be run (this fixes the length) will depend on the individual judgment and experience of the estimator, the nature of the building (more particularly that of the ceiling), and whether the conductors are to be carried on or below the surface. As can be seen, this leaves plenty of scope for variation in the final lengths taken. The total voltage drop from point of supply to lamp will be distributed over main feeder, sub-feeder, and circuit, and consequently the size of the conductor will depend on the percentage of the total voltage drop which is allowed for the conductor in question. In addition, the size of conductor will be influenced by the current density chosen. This should always comply with the I.E.E. rules unless otherwise specified.

3. *Take Off Quantities.*—This is straightforward, may be done with the aid of a map-measuring instrument or rule, and for the same plan should not introduce any appreciable error. In all large installations it is greatly facilitated by using schedules in which the material for each circuit, as measured, may be entered up. A certain percentage should, of course, be added to the net quantities to allow for cutting and breakages and an item included for sundries, such as solder, tape, screws, &c.

4. *Decide on Quality of the Materials to be Used.*—It is probably at this point that the greatest variations in the estimates are introduced. For the same class of material there are wide differences in price depending on the quality, and even where the quality may be assumed to be the same, the price offered by a firm in a ring will differ from that put forward by one outside. It is seen, therefore, that even when it is rigidly laid down what quality of material is to be used, there may still be considerable differences in price. It would appear to be almost impossible to avoid this, particularly when competition is keen, and it is advisable, even when material is closely specified, to call for samples before the order is placed. It is not necessary to call for these with the estimate, but only from those few firms which, after a scrutiny of all estimates, appear to be the most suitable. All firms, when putting forward their quotations, should clearly indicate the quality of material which they are offering, and, if necessary, state the name of the maker.

5. *Price the Quantities.*—When operations 3 and 4 have been completed, this is straightforward work, and should introduce no error. Self costs should be used. To obtain total material add self cost.

6. *Take Off Labour.*—Speaking generally, this is usually the most unscientifically treated part of the estimate. It is customary to place this item in the estimate at so many shillings per point, the figures being based on past experience, but not necessarily being in the least suitable for the conditions of the job under consideration. It is preferable to calculate the time required to erect each item of material included, separately, and add to obtain total time for the job. This may be done most readily by the aid of labour constants to which suitable corrections may be made to allow for variations in the assumed standard conditions on which these constants are based.

7. *Price Labour.*—Add all the individual times found under 6 and price at current rate of wages for wiremen. Very considerable differences in the final estimates may be caused if the rate used is not the current trade union rate, the intention of the contractor being to use apprentices or non-union labour.

8. *Obtain Total Self Cost.*—This is made up of total material self cost as found under 5, and total labour self cost as found under 7, together with items to cover freight and packing when necessary, contingencies, to cover errors in calculation and unforeseen occurrences on the job, &c., percentage of engineers, travelling expenses, fares, and out-of-town allowances for wiremen when necessary, allowance for incurring the penalty, if any, corporation inspection fee, &c. Variations in the final estimate may be introduced here, particularly under the contingency item, but they should not be very large.

9. *Add Overhead Charges.*—The figures obtained under 8 represent the total net self cost of the job to the firm. To these must therefore be added such proportion of the overhead expenses as is considered appropriate for the size of the job. It is an extremely difficult matter to satisfactorily calculate this percentage, as it depends on so many conditions. Few of these will be the same for any two firms, and consequently wide differences in the estimate may be introduced here. Many of the smaller firms, particularly those which keep no office staff, completely neglect this item, giving them a very considerable advantage on most small work, but at the same time almost inevitably leading to failure.

10. *Add Profit.*—To the gross self cost obtained by adding overhead expenses to net self cost is now to be added the profit. This will, of course, differ, depending on the keenness with which any one firm wants the job, but should not account for more than about 10 per cent. difference in the final estimate.

11. *Check.*—All previous calculations and prices should now be independently checked. It may be assumed that the estimator himself will have submitted his work to a rough check, but it is always advisable to have each separate item checked by another man before finally sending the estimate in.

12. *Dictate.*—The estimate is now in its final form and may be dictated. It is extremely important, from the contractor's point of view, so that his offer should have its fair amount of consideration, that he should clearly specify what he is putting forward and under what conditions he has calculated his price. Therefore, he should specify the number, type, and size of the lamps he proposes to use, the quality of material (wire, conduit, switches, &c., preferably with maker's name) he has included, and any regulation to which he proposes to adhere (such as I.E.E., corporation, or insurance); he should also particularly stress any points of his offer which he thinks may differ from those of his competitors and which, in his estimation, give additional advantages to the installation.

To obtain reliable estimates on a comparative basis, the whole of this work must be done. The contractor may be relieved of certain parts of it by the consulting engineer, who is responsible for a specification and bill of quantities, but it is only the larger jobs which can carry the extra expense of the engineers' fees. The most consistent results will, of course, be obtained when all offers are made to a specification, but many specifications needlessly enhance the cost of the work by introducing fads, and when all is said only put forward one man's idea of how the installation should be carried out; whereas estimates independently worked out by several contractors on the above lines give more scope for finding the best solution.

The above remarks deal primarily with estimates for lighting installations, but, with certain modifications, they are applicable to those for power installations as well.

The Berlin Accumulator Works.—The majority control of the undertaking of the Accumulator Works Co. of Berlin and Hagen, which dominates the secondary battery trade in Germany, including the Tudor type, and in which the A.E.G. is interested, has now passed into other hands. It had been intended at the recent meeting to propose the issue of preference shares, apparently with multiple votes, to prevent the "alienation" of the undertaking or the transfer of control to other parties. It was, however, found impossible to proceed with this scheme in face of the fact that out of the 13,104 shares represented at the meeting no fewer than 9,925 were found to be in the hands of the textile firm of Gunther Quanat, of Pritzwalk, North Germany. Nevertheless, it was decided to increase the ordinary share capital by 20,000,000 marks and to offer the new shares to existing proprietors on an equal basis, so that the new control, which has resulted in the election of four new directors, will thereby be maintained. The interest held in the accumulator company by the Berlin Handels Gesellschaft, in which Herr Stinnes recently participated, has also been weakened by the re-grouping of the accumulator company.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Bell" Electric Washer.

Electric clothes-washing machines of British manufacture are not so numerous that we can afford to ignore any developments of this nature, and we are therefore glad to be able to give some details of a purely British washer made by the "Bell" Washer Co., Feilden Street, Blackburn. The machine (fig. 1) is an adaptation of a hand-driven type and employs an oscillating dolly which, it is claimed, actually scrubs the clothes and forces water through them. The

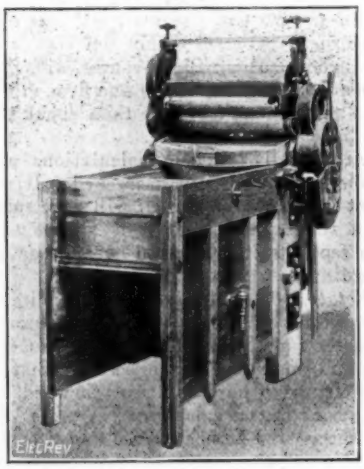


Fig. 1.—The "Bell" Washer.

wringer rollers are of more ample dimensions than those usually fitted to electrical washers, being about two feet in length and proportionately large in diameter. The principal feature, however, is the way in which the safety of the operator is ensured. The system is seen in fig. 2. Two rollers, about 2 in. in diameter, are mounted in a frame in such a way that when the machine is running the lower

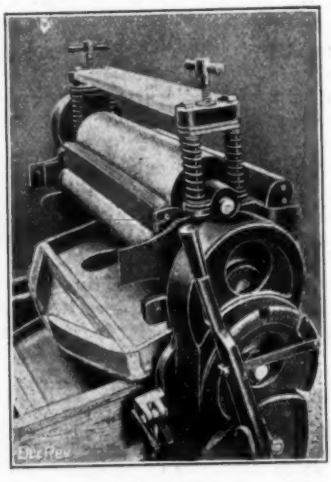


Fig. 2.—Safety Device.

roller is retained against the lower of the main rollers by a weak spring. The pressure is sufficient to pick up any article of clothing, but insufficient to drag in the operator's fingers should they come into contact with the small roller. Accidental contact with the main rollers is prevented by the frame in front of them. When the direction of the wringer is reversed, the guard can be swung over to the other side.

The "C. & H." Junior Wireless Set.

The "C. & H." junior set has been developed to meet the demand for a small, inexpensive, and simple wireless receiver that will enable one to receive the broadcast programmes without having any knowledge of electricity or wireless theory. The set consists of a polished hard-wood box with a matt surface ebonite top panel. The dimensions are 4¼ in. square with a depth of 4 in.; the tuning coil and switch, contained inside case, are therefore protected. Although of such a small size this instrument, fig. 3, is not a toy.

All that is necessary to receive music and speech, &c., is to connect the instrument to an aerial wire and an earth and

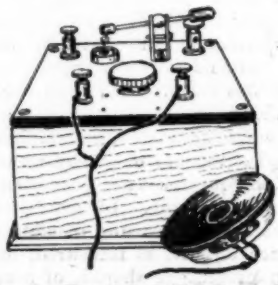


Fig. 3.—The "C. & H." Radio Set.

"listen in." With a well-constructed aerial of the regulation size, the set will have a range of approximately 15 miles from the broadcasting station. The set is manufactured by Messrs. F. Pratt & Co., 23, Queen Anne's Gate, Westminster, S.W.1.

An Electric Hygrostat.

A simple device to prevent the humidity insde a piano or cabinet rising below a fixed maximum has been recently put on the market. In the case of a piano a small hygrostat is fixed near the two and wired in series with two 8-c.p. carbon filament lamps placed at the bottom, which are permanently connected to the electricity supply. The function of the hygrostat is to switch on the lamps when the air reaches a predetermined degree of humidity; the warmth of the lamps sets up a circulation of dry air inside the piano, and, by raising its temperature above that of the surrounding air, prevents condensation taking place. The lamps remain on until the air reaches the necessary degree of dryness, and are then switched off. It is found that when pianos are fitted with this device they keep in better tune with much improved tone, and are rendered immune from all troubles arising from being left in a damp room. Mr. Percy Watson, of the Northern Electrical Co., Grimsby, is the patentee, and the device is being manufactured by Messrs. Berry's Electric, Ltd.

The "Mepic" Shop-window Heater.

Every shopkeeper knows how a misty window detracts from a display, and, indeed, often obscures it altogether. In order to get rid of this condensation and to keep the window glass clear, the Midland Electric Power Installation Co., has devised a low-wattage heater in the form of a cylindrical bar. This, it is claimed, entirely eliminates the moisture which would otherwise collect on the window, and it is so arranged that a number can be connected up end to end. The cost of energy is infinitesimal.

"Osram" Automobile Lamps.

The latest pattern of automobile headlight lamp—introduced by the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2—is an 18-W gasfilled lamp for 12-14 V, in a 35-mm. diameter bulb. This is an intermediate size, specially manufactured at the request of the motor industry. The company's

Fig. 4.—An "Osram" Automobile Lamp Case.

lamp case, one of which is illustrated in fig. 4, are a safe and convenient means of keeping spare lamps. The smaller size measures 5½ in. x 3¾ in. x 1⅝ in., and carries two headlamps (up to 35-mm. diameter), two side or tail lamps, a dashboard lamp, and a "festoon" lamp. The larger case is designed to take headlight lamps with a maximum diameter of 50 mm.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The "Standard" Brush-Holder.

We are interested in a leaflet which has reached us relating to a patent brush-holder manufactured by the Standard Carbon Brush Holder Co., Ltd., which was reviewed in a recent issue of the Review. It is claimed that this new brush holder and the method of fixing it in the rocker embody many new features, and represent a considerable advance on any gear previously used.

On examination, we are of opinion that this gear is very similar to that which has been standard with Messrs. Flather and Co., of Leeds, for the last fifteen years, and presents no material improvement. The method of rigidly fixing the brush spindle in a slot in the rocker, the clock spring adjusted by means of a central rotating pin, the packing pieces to compensate for commutator wear, and the ease with which the brush spindle may be removed from the rocker, are all present in the Flather brush gear.

On comparison, the slight variations on the above features that the Standard Brush Co. have adopted will not be considered improvements by most practical engineers. The only important claim that the Standard Brush Co. make is that individual brush boxes may be removed without disturbing others, but this advantage does not to our mind seem of great importance when in the case of the Flather gear the whole spindle may be removed from the rocker by merely loosening two small set-screws.

While congratulating the Standard Carbon Brush Holder Co., on producing a gear with so many excellent features, we think that the credit for the novelty is due to Messrs. Flather & Co. It is surely a tribute to Messrs. Flather & Co. that this important feature in their motor design is likely to be adopted by other leading manufacturers as a standard.

Bates & Windibank.

London, *October 25th*, 1922.

Shift Engineers' Salaries.

The E.P.E.A. got, by the schedule, over 30 per cent. average increase for all the other grades, but only 12 per cent. for the shift engineers, yet the shift engineers are reduced by 3.6 per cent. at every reduction, while most of the upper grades are only reduced by 2.5 per cent. In the name of common decency, isn't it high time that the 12 per cent. squad marked time for a bit while the 30 per cent. merchants carried on with the reductions, if necessary? A reduction of 4 per cent. for all other grades would, in most cases, bring about the same total reduction in the wages bill.

Fairplay.

October 30th, 1922.

Your correspondent "Welfare" says that the E.P.E.A. has left a lot undone. Too true! but the elections are at hand. It is to be hoped that the shift men will not forget that, according to official figures in the *Journal*, the schedule, in addition to putting them at the bottom, gave them 12 per cent. increase against 33 per cent. for all the others. Let the election cry be "Grade 5 for all shift men and six-hour shifts for all stations over 20,000 kW."

It's no use going on being catspaws. Let us get on or get out. There are other unions that look after their own if the E.P.E.A. won't.

Fed-up.

October 31st, 1922.

The British Trade Outlook in Canada.

After reading your leading article to-day I should like to say that the prospects for a British manufacturer of electrical goods in Canada are not different from his prospects in Manchester or London. Sales in Canada follow most surely from those efforts which produce sales in England.

"Special Efforts," "Branch Factories in Canada," &c., are very fine trimmings, but are not the foundation material of a steady stream of orders.

The mystery, if there is one, lies rather in persistence. The British manufacturer need not expect results in Canada any more than he would in the home market, so long as he goes fishing on fine days only.

Until the location of his office or warehouse in Canada becomes familiar to all, until his telephone number and telegraphic address are stamped on the memories of buyers, until his travellers know all the jobbers and retailers by their first names, until he is recognised as an institution whose products have been, are, and will be available winter and summer, year in and year out, he will not have tapped the market for more than sample orders.

Agents should therefore be selected, or direct branches established, whose motto is patience and permanence. These in turn should be backed up by a willingness on the part of the manufacturer himself to supply purchasers with the goods they ask for and are accustomed to, rather than to attempt to restrict them to the products which his factory has been turning out in the past, for other markets.

W. H. Munro.

London, *October 27th*, 1922.

Fixing the Price Per Point.

Can you, or any of your readers, inform me of the method of arriving at a fixed price per point in a housing scheme where no meters are installed? It is desired to set a weekly charge for each house, varying according to size, which shall be fair alike to consumer and supply company.

J. Lauder.

Glasgow, *October 30th*, 1922.

[The Fixed-Price Light Co.'s charges for a similar class of supply were outlined in our issue of May 15th, 1914.—Eds. Elec. Rev.].

Estimating for Internal Wiring Contracts.

It might interest Mr. Alan Kirk and your other correspondents on this subject to know that the Scottish contractors have worked to a standard schedule for some years.

"The Scottish Mode of Measurement for Electrical Work" was adopted in 1918 by the E.C.A. of Scotland in conjunction with the architects and surveyors, and embodies most of Mr. Kirk's suggestions. It is a Government publication, and can be got from H.M. Stationery Office for 1s.

Randolph.

October 23rd, 1922.

Salesmanship in Relation to Small Electric Fires & Cookers.

There is one point to which I would like to draw attention in connection with the above subject recently discussed at the E.D.A. Salesmanship Conference, namely, that the cost of wiring a heating point in many houses where lighting is already installed is prohibitive, and frequently is more expensive than the actual fire. If this item of expense were not present, the demand for electric fires would be much greater as there are a vast number of cases where the deciding factor for not installing electric fires was the cost of wiring.

F. E. Rowland.

London, *October 30th*, 1922.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR SEPTEMBER, 1922.

The September official figures of electrical export business show that the upward tendency of the last two months was, unfortunately, not maintained, the total amount for the month under review being £778,007, a falling off of over £85,000. Decreases occurred in all sections of the electrical exports with the exception of electrical machinery (£11,000 increase) and batteries and accumulators (£9,000 increase), the principal decreases occurring in insulated wires and cables (£28,000 decrease) and telegraph and telephone cable and material (£57,000 decrease). Electrical imports for the month only reached £200,932, a falling off of £118,000 as compared with the previous month, principally accounted for by a decrease of £100,000 in the electrical machinery import section.

Re-exports at £11,770 were £1,000 lower than in August.

Values of Electrical Exports and Imports for September, 1922.

	Exports. £	Imports. £	Re-exports. £
Electrical goods and apparatus	99,911	36,867	2,771
Insulated wires and cables	125,540	25,537	50
Glow lamps	28,503	14,375	1,105
Arc lamps and parts	693	1,795	165
Batteries and accumulators	44,014	18,613	450
Meters and instruments	19,840	5,233	839
Carbons	6,691	1,172	478
Electrical Machinery.—			
Railway and tramway motors	19,484	—	—
Other motors and generators	117,614	—	—
Switchboard (not telegraph or telephone)	8,961	—	—
Electrical machinery (unenumerated)	116,767	71,444	4,245
Telegraph and Telephone cable and material.—			
Telegraph and telephone wire and cable (not submarine)	30,818	1,997	—
Submarine telegraph and telephone cable	4,956	—	—
Telegraph and telephone instruments and apparatus	154,215	23,899	1,667
Total	£778,007	£200,932	£11,770

THE TISBURY HYDRO-ELECTRIC SCHEME.

The enterprise of those who undertook the harnessing of the local water-power in order to provide a supply of electricity at Tisbury, in the neighbourhood of Salisbury, reached a practical stage in February last, when the plant was officially set in motion. In order to carry out the project, the Tisbury Electric Supply Co., Ltd., was promoted by Edmundson's Electricity Corporation, Ltd., in combination with the Salisbury Electric Light and Supply Co., Ltd. (which is closely connected with Messrs. Edmundson), and a number of local residents. Of the share capital of £5,000, half was subscribed by Edmundson's Corporation and the Salisbury E. L. and S. Co., Ltd., while the other half of the shares is held by about 60 local people. The plant was installed by Messrs. Edmundson, and the technical management of the undertaking is in the hands of the Salisbury E. L. and S. Co., Ltd., Mr. A. B. Randall being the managing director of the latter, as well as of the new company. The old Tisbury corn mill has been obtained by the company on a 40-years' lease from the Dowager Lady Arundell, who considerably helped the promotion of the scheme. The old water-wheel was removed to make room for the turbo-generator plant on the ground floor, while the room above serves the useful purpose of storage accommodation; the stable was converted into a storage battery room, and the Mill House is in course of being renovated preparatory to being occupied by the resident engineer-in-charge, Mr. A. Lee Cann. The various alterations and improvements to the water-way were carried out under the supervision of Mr. E. Doran Webb, chairman of the directors of the new company.

The water turbine was supplied by Messrs. Hay, Maryon & Co., and is capable of developing 24 h.p. with a flow of water of 2,000 cu. ft. per minute and at a head of 8 ft.; it drives by means of belting a d.c. 210-volt generator. A 4-cylinder internal-combustion engine to run on paraffin oil and direct coupled to a 20-kW generator has been provided by the Keighley Electrical Engineering Co., Ltd., and will be used as a stand-by, available for use in case of shortage of water or if it should be necessary to shut down the water-power plant for repairs or any other reason. The battery of accumulators was supplied by the Chloride Electrical Storage Co., Ltd., and has a capacity of 300 ampere-hours; the motor-generator is of Messrs. Higgs Bros.' manufacture, while the 5-panel control switchboard was made at the Park Royal Engineering Works, Ltd.

The method of distribution adopted is the 2-wire overhead one, and about two miles of mains had already been erected on creosoted poles when the supply commenced. Street lighting has been undertaken, and amongst the public buildings connected to the mains are the Victoria Hall, workhouse, police station, and three or four places of worship. A number of business and private houses, totalling about 30, were wired in anticipation of being electrically lighted, while agreements had been come to to light 20 other premises as soon as the supply became available. The company therefore started business with about 50 consumers, and in this respect Tisbury may be said to have done well, seeing that in Salisbury the supply company started in 1898 with 25 consumers, which number had increased to 57 at the end of six months.

Tisbury has approximately 1,700 inhabitants, and it is believed that it will be possible to generate by means of water-power practically all the electricity that will be required, at least for some time to come; the directors therefore confidently anticipate a successful future for the new company.

Liebmann Memorial Prize.—The American Institute of Radio Engineers has awarded the Liebmann Memorial Prize for 1922 to Mr. C. S. Franklin, research engineer of Marconi's Wireless Telegraph Co., Ltd., for his investigations relating to short-wave directional transmission and reception.—*The Times.*

REVIEWS.

Railway Electric Traction. By F. W. Carter. Pp. viii+412; figs. 204. London: Ed. Arnold & Co. Price 25s. net.

There is ample room for another book on electric traction, and it is all the more satisfactory that this book should come from so eminent an authority on the subject as the present author. The present volume, in addition to its other merits, possesses that of being well written. Its one great drawback is its one-sidedness. Had Mr. Carter treated the single-phase system with the same thoroughness and competence as he has treated the continuous-current system he would have attained a far finer result. As it is, the strong bias he expresses against the single-phase system does discredit to his learning. A few years hence we may hope to find scholars writing about traction from an independent and objective standpoint, but at present most authors seem to be too anxious to further certain interests or advocate views of their own. The present book, therefore, we consider to be an excellent treatise on continuous-current traction. It certainly contains much useful, if somewhat scrappy, information on alternating-current systems, but the opinions are essentially those of a strong advocate of the continuous-current system, and, from their one-sidedness, might equally well be used, *mutatis mutandis*, by a strong advocate of the single-phase system. "The question of system must be viewed broadly, if it is to be decided judicially" is a statement which the author found easier to make than to act upon. When we are told that in America "Time has dissolved the illusions (*re* systems), and little of the controversy now remains," we wonder what all this booming of the 3,000-volt continuous-current system means, or what is the object of the vigorous activities of the rival American firms carried out on this side of the Atlantic. Certainly many eminent American engineers will disagree. Again, to describe Continental development as bureaucratic engineering does not reveal true scholarship, any more than giving the Prussian railways credit for leading the 1-phase system in Europe does. Nor is it right to infer that decisions can scarcely be re-considered. How about the French, Dutch and Berlin railways; also some of the early American railways where changes were made after great expense had been involved? And who would be so bold as to say that the 1,500-volt, continuous-current system will become the standard system in Great Britain?

Coming now to the contents, the author does well to emphasise that hitherto electrification has usually been adopted as an expedient for overcoming abnormal difficulties of working. The useful part of the book begins with the chapter on "The Locomotive." The author considers the tram-suspension to be the commonest drive for locomotives—probably American locomotives is meant here. It remains to be seen whether this drive or the drives favoured in Europe will ultimately survive. The author's view that the former is based on "natural and sound lines of evolution" seems premature. There is much excellent matter in this chapter, some of which is essentially mechanics, and might equally well be found in a treatise on steam locomotives. Under "riding of locomotives" a number of important matters are dealt with, such as: pressure on rails, interaction between wheel and rail, motion on curved track, alignment, equations of motion, inertia, blows on rails, gear-teeth and journals. Vibrations in side-rod locomotives are dealt with at length, but more attention might have been paid to the modern remedy—elasticity.

The chapter on railway motors deals first and fully with continuous-current motors for motor-coaches, but the locomotive types are treated rather meagrely. Regeneration is not well considered—in a book of this kind the engineer has a right to expect the principles set forth in detail. Motor control fills a long chapter, in which the writer is very successful. For calculating the resistance steps in the starter the author presents a method based on the use of universal curves, which should be useful to switchgear designers, who constantly deal with this matter. Though contactors are still used on 1-phase locomotives, we should like to see due attention given to the controller or tap-switch type, which has been widely used of late years in Europe. The chapter on the distribution system contains a lot of useful information. The question of interference with communication circuits gives the author a good chance of indicating his preference for the continuous-current system, though he does not dwell on its effects when a short-circuit with unlimited power behind it occurs. Of course the 1-phase system is capable of producing much disturbance, entailing, at times, costly remedies, such as removing the weak-current circuits from the track. It should not be forgotten, however, that in some cases these circuits had to be removed to make room for the overhead equipment, or to prevent danger from broken wires, whatever system was adopted. Mr. Carter, indeed, reminds us that the steam-worked railway has grown up around the steam locomotive, and that it would be unfair to electrical operation to judge it as limited by the methods of steam operation. As is well known, the chief interference trouble experienced in this country has been caused by rotary converters feeding continuous-current tracks.

In connection with power equipment and systems of electrification, here again we find widely-varying views, indicative of vigorous and healthy development. On the one hand these

is the great movement for a common 50-cycle supply for all needs, including traction; on the other hand, there is the sharp separation of the traction from the other loads, with the consequent possibility of a separate frequency for traction with coarser regulation, &c.

Two chapters are devoted to the mechanics of train motion —a subject with which the author has made himself fully conversant. It is this kind of information which will make the book of such great value to railway engineers, and which in itself would be sufficient to justify its recommendation.

The book is well printed and illustrated, but some of the photographs are poorly reproduced—indeed, they appear to be taken from catalogues rather than from originals. The reader will have gathered that, in the reviewer's opinion, Mr. Carter is much more at home with American than with Continental practice.

Alternating Current Electrical Engineering. By Philip Kemp. Second edition, 1922. Pp. xii+515; 406 illustrations. London: McMillan & Co. Price 17s. net.

The first chapters of this book deal with elementary a.c. theory. The treatment is simple and commonplace, and does not differ appreciably in method from other text books of the same type.

Chapters XI to XXXI deal with practical applications of the theory given in the preceding chapters. These chapters are uniformly superficial. They are in most cases very readily followed, and an inexperienced reader might easily have the delusion that he knew something about the subject treated, after perusing them.

The earlier parts of the book seem to be very accurate, but this standard is not wholly maintained. Definite mistakes are generally avoided, but vague statements which are quite as blameworthy abound. For example, in dealing with current transformers on p. 192, it is stated that "the phase displacement is roughly proportional to the secondary current." On p. 318, in the chapter on Transmission of Power, the reason given for using stranded conductors in e.h.p. lines is to obtain "a uniform distribution of stress."

The book is evidently a commercial success and will probably have many admirers. The reviewer is not among these admirers and he must put on record his opinion that the real educational value of the book is very small.

The work of the publishers is well done, but some of the illustrations have done duty in too many books and catalogues already.

Wireless for the Home. By Norman P. Hinton, B.Sc., A.C.G.I. Pp. xii+87; figs. 35. London: Sir Isaac Pitman and Sons, Ltd. Price 2s. net.

This little book is an excellent guide for those who, with no knowledge of the subject, wish to fit up receiving apparatus for the new broadcasting scheme, especially if they defer till the last the reading of Chapter 1, which introduces, with little explanation, the names of apparatus described later on. The book is, in fact, just the sort of introduction to the subject which will be useful to those who want to make a start with the new hobby at once without spending the time and trouble required for the study of fuller and more advanced text-books.

The author strives, usually with success, to be simple, though it is easy to see that he is often longing "to let himself go." His explanations are rather sketchy and disconnected at times, but in some cases, as in the difficult one of heterodyne reception, they are delightfully clear, and they are always concise, unlike so many books written from a popular standpoint.

In the chapter on the aerial, the dimensions given for the aerial itself are not those now in force, but this is a small matter, as the correct dimensions are laid down in the licence, and, with this exception, all information in the book is accurate and up-to-date.

There are a few misprints, as "times" for "miles" on page 22, and "tripod" for "triode" in fig. 31a, which, incidentally, should read "fig. 31," but the book is excellently printed on good paper and contains 35 well-reproduced illustrations and diagrams.

BUSINESS NOTES.

Bankruptcy Proceedings.—John William Paul Adams, Market Street, Polesworth, Warwickshire, electrical engineer.—The public examination of this debtor was held on October 25th at the Court House, Corporation Street, Birmingham. The statement of affairs showed liabilities of £271, against assets of £91, or a deficiency of £180. Debtor attributed his failure to bad trade and becoming guarantor for another. It appeared that he commenced business in 1917, and was successful until March, 1921, when by reason of the coal strike the takings declined, and did not recover. Debtor was closely questioned with reference to a newsagent's business which he alleged had been carried on by his daughter, assisted by his wife. After further questions the examination was adjourned.

Horace John Albert Maullin, 206, Lozells Road, Hockley, Birmingham, house painter, and also trading as the Wilton Engineering Co., at 124, Devonshire Street, Birmingham, electrical engineer.—The public examination of this debtor was held on October 25th at the Court House, Corporation Street, Birmingham. The statement of affairs showed liabilities of £254, against assets of £44 10s., or a deficiency of £209. Debtor stated that he commenced business as a house painter in 1890 with a capital of £900. The electrical engineering business was commenced in February, 1921, with the idea of providing employment for two of his sons. He had £400 capital at the time, all of which was expended in plant and machinery. He had been in financial difficulties for some time, and several unsuccessful attempts were made to dispose of the business as a going concern. He would not have been in difficulties if he had not branched out into the electrical business. The examination was closed.

W. Shaw, Junior, electrical engineer, 26, Westcliffe Road, Shipley.—Receiving order made October 28th on debtor's own petition.

E. W. Morgan, company director and electrical engineer, Eccles Mill, Monton Lane, Eccles.—Last day for proofs for dividend, November 15th. Trustee: Mr. J. G. Grant, Official Receiver, Byrom Street, Manchester.

R. T. Morrison, electrical engineering contractor, 82, Lumb Lane, Bradford.—First and final dividend of 4s. 8d. in the £, payable November 8th at the Official Receiver's office, 12, Duke Street, Bradford.

A. Kershaw & C. H. Wood (Kershaw & Wood), electrical engineers, 9, Bradford Road, Dewsbury.—Trustee, Mr. C. Turner, 155, Norfolk Street, Sheffield, released September 22nd.

Company Liquidations.—Southport Tramways Co., Ltd.—A meeting of members is called for November 30th at 88, Kingsway, W.C., to hear an account of the winding-up from the liquidators, Messrs. H. A. Stagg and T. Bower.

Rotax Motor Accessories Co., Ltd.—A meeting of members is called for November 29th at Rotax Works, Willesden Junction, N.W., to hear an account of the winding-up from the liquidator.

Rhondda Tramways Construction Syndicate, Ltd.—A meeting of members is called for December 1st at 62 and 63, Queen Street, E.C., to hear an account of the winding-up from the liquidator, Mr. W. B. Cownie.

Midland Electric Co. (Southport), Ltd.—A meeting of members is called for December 4th at the offices of Messrs. Davies & Crane, Hoghton Chambers, Southport, to hear an account of the winding-up from the liquidators, Messrs. W. A. Bond and J. A. Bond.

Dissolutions of Partnership.—J. Glenn & Co., motor engineers and electricians, Ayston Road, Uppingham, Rutland.—Mr. J. H. Glenn, Mr. W. Glenn, and Mr. S. J. A. Walker have dissolved partnership so far as regards Mr. W. Glenn, who retires from the firm.

The Re-echo Wireless Manufacturing Co., manufacturers of wireless receiving sets, 16A, Hatton Wall, E.C.—Messrs. S. F. O'Hara, J. B. Bignamy, and H. R. Howling have dissolved partnership.

Baillie & Hutchison, electrical engineers, 85, Main Street, Cambuslang.—Mr. J. C. Baillie and Mr. W. B. Hutchison have dissolved partnership. Mr. Hutchison will attend to debts and continue the business on his own behalf.

Hayes & Hayes, electrical engineers, Fulwood House, Fulwood Place, High Holborn, W.C.—Messrs. L. and W. M. Hayes have dissolved partnership.

Trade Announcements.—With reference to the death of Mr. Fernand Espir, notified in our pages last week, we learn that the remaining partners in the business, Messrs. Jules and Henri Espir, will continue to conduct the business of the firm under the same name at 3, East India Avenue, London, E.C.

New showroom premises at Townend, Pontefract, have been opened by the Electrical Contracting & Motor Co.

Catalogues and Lists.—Messrs. William Sanders & Co., Falcon Electrical Works, Wednesbury.—A price list of "Rushall" cable sockets in sizes of from 15 to 200 A.

Holophane, Ltd., Elverton Street, Vincent Square, S.W.1. —An illustrated leaflet dealing with the "Filterlite" totally-enclosed bowl for semi-indirect lighting.

Igranic Electric Co., Ltd., 147, Queen Victoria Street, E.C.4.—Leaflet No. 180, illustrating and describing ironclad motor starting panels. Full dimensions are given.

Messrs. Lionel Robinson & Co., Ltd., 3, Staple Inn, W.C.1.—An illustrated folder giving prices of "Ballsok" insulating beads.

Messrs. Bastian & Allen, 58, Haymarket, S.W.1.—An illustrated pamphlet describing the "Bastian" hot-water geyser.

Messrs. A. C. Alexandra & Co., 10, Iddesleigh House, Caxton Street, S.W.1.—Two price lists of "Omega" electric lamps for domestic and other uses.

T. V. Wireless & Electrical Supplies, Latimer Road Works, Teddington.—An illustrated price list of electrical accessories.

The British Vacuum Cleaner & Engineering Co., Ltd., Parsons Green Lane, S.W.6.—Catalogue No. 228, dealing with pneumatic suction plant for various purposes.

Messrs. Herbert Kennedy & Co., Ltd., 47, Victoria Street, Westminster, S.W.1.—In our issue of October 20th we acknowledged the receipt of an illustrated booklet describing what was referred to as the "Electroscope." The right designation of the instrument is, of course, the Elverson "Oscilloscope," and we trust no confusion was caused by the error.

Glasgow Electrical Engineering Co., Ltd., 45-47, Pitt Street, Glasgow.—An illustrated booklet describing automatic self-regulating wind dynamo installations.

Bayliss Duddleston Electric Supplies, Weaman Street, Birmingham.—Particulars of the "Victory" 500-W bowl-fire.

L. G. Hawkins & Co., Ltd., 116, Charing Cross Road, W.C.2.—A pamphlet entitled "The Illusive Therm," advocating the use of electricity in place of gas and illustrating a number of domestic appliances.

Messrs. Ferguson, Pailin, Ltd., Edward Street, Higher Openshaw, Manchester.—Catalogue Section No. 160, A2, giving illustrated descriptions of industrial and mining-type switchgear, including automatic and non-automatic draw-out and non-draw-out patterns for wall or floor mounting.

Venner Time Switches, Ltd., 45, Horseferry Road, S.W.1.—A folder advertising time switches for use in connection with shop-window lighting, &c., and a pamphlet illustrating and describing the action of these switches.

Messrs. Dieny & Lucas, Ltd., 329, High Holborn, W.C.1.—An illustrated price list of squirrel-cage and slip-ring motors made by the Société Alsacienne de Constructions Mécaniques—the firm's principals.

The Wholesale Fittings Co., Ltd., 23, 25, and 27, Commercial Street, E.1.—An illustrated and priced catalogue of lighting fittings of "Supastone" "three-ply" glass.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—A well-illustrated list of "Sunco," "Belling," "Cosmos," "Jackson," "Flamingo," "Revo," "Heatrae," "Premier," and "Magicoal" electric fires. Priced.

The British Thomson-Houston Co., Ltd., 77, Upper Thames Street, E.C.4.—Incandescent Lamp Handbook No. 3c, giving particulars of lamp bulbs for various makes of automobiles. Also a booklet (L. 228) dealing with the "Tungar" rectifier, and a folder illustrating artistic lighting pendant fittings.

Messrs. E. P. Allam & Co., 107-109, Gray's Inn Road, W.C.1.—A stock list (November) of d.c. motors.

Messrs. Henderson & Thornton, Ltd., 3, Percy Street, Tottenham Court Road, W.1.—October net trade price list of electrical accessories, including conduit and fittings, switch- and fuse-gear, wall plugs, lampholders, &c.

"Lamlok," Ltd., 36, Rusthall Avenue, Chiswick, W.4.—Two illustrated and priced pamphlets dealing with the firm's lamp-locking device, and a mailing-card bearing a sample.

Messrs. W. J. Furse & Co., Ltd., Traffic Street, Nottingham.—Two illustrated descriptive pamphlets dealing respectively with an electrically-controlled curtain for theatres, and electric lighting dimmers.

The Anglo-American Electrical Co., 101, St. Vincent Street, Glasgow.—An illustrated pamphlet dealing with the "Pallas" vacuum cleaner; also a description of the "Anglectra" bell transformer.

The Runbaken Magneto Co., Ltd., Derby Street, Manchester.—An illustrated price list of automobile accessories, including accumulators, sparking plugs, dimming switches, &c.

The British Empire Exhibition.—We have received from the director of the British Engineers' Association, 32, Victoria Street, London, S.W., a brochure giving full particulars of the Shipbuilding, Marine, Mechanical, and General Engineering Section of the British Empire Exhibition, Wembley Park, 1924, for which the Association has authority to let space to any British engineering firm. It is urged that provisional applications for space should be sent in at once.

A Test of Strength.—A test of the strength of "Osram" lamps was provided by a collision between two motor cars and a street lighting standard at Windsor recently. Although the standard was broken in three places, the 200 c.p. "Osram" lamp mounted on it remained intact. This method of testing lamps, however, is considered too expensive for general adoption.

"Freezor" Fan Competition.—The General Electric Co., Ltd., announces that the following have been awarded prizes for the best window displays advertising "Freezor" fans:—1st (£25), Messrs. Edmundson's Electricity Corporation; 2nd (£10), Messrs. Thomas Gunn, Ltd., Fore Street, E.C.2; 3rd (£5), Mr. L. Hancock, Grimsby; consolation prizes (£1): Messrs. Watson, Marsh & Co., Harding Bros. (Hereford), and H. Fenimore (Eton).

Small Electrical Vehicles.—As a consequence of the high selling prices of German motor cars equipped with internal combustion engines and the high working expenses, attention is now being directed by two firms to the introduction of small electrical vehicles for town use. The efforts lie in the direction of producing light one- or two-seater cars, and light delivery cars for the transport of about 2 cwt. of goods and capable of rendering services to many small traders.

Fuller's United Electric Works, Ltd.—Circulars have been issued calling a meeting, by Order of the Court, to be held at Winchester House, E.C., on November 9th, for the purpose of passing a resolution to enable the company to enter into a compromise or arrangement with its creditors, and for the re-organisation of the company's finances. A statement of facts, leading up to the present position, has been issued. Preliminary meetings of the creditors and shareholders have already approved the outline of the proposed scheme, and the resolutions to be passed at the forthcoming meetings are to enable the scheme to receive final approval.

New London Commerce Degree Bureau.—A new bureau under a University of London Trust, has been opened at 46, Russell Square, W.C.1, for the assistance of external students for the University Commerce Degree. Students in the provinces and elsewhere reading for this degree who cannot attend suitable colleges or classes are invited to communicate with the secretary (Mr. H. J. Crawford, B.A.). There is a staff of experienced educational advisers. The bureau is also the recognised employment agency for London University graduates, and employers wishing to get in touch with London-trained men and women are requested to make their wants known to the secretary. We understand that the Bureau's charges are small, as it is not a profit-making body. Prospectuses may be had from the secretary.

Lead.—Reporting under date October 28th, Messrs. James Forster & Co. state:—"The Metal Exchange this week has been the centre of an enormous speculative activity in tin, spelter and lead, the transactions on the latter metal reaching 6,000 tons, half of which was for January shipment; large purchases have also been made for February and March. Trading in actual lead has been on a very small scale, consumers being well supplied. Although trade is better than it was, there is certainly nothing to justify such a market as we have had this week. Arrivals this month are again on a large scale, London and Liverpool alone up to date having received about 15,500 tons, according to the Customs Entry Lists."

Tenders for Lamps for Johannesburg.—The *South African Mining Journal* quotes the following prices recently tendered to the Johannesburg Municipality as an indication that the lamp trade is in a decidedly unsettled state at present:

Tenderer.	Price per dozen. 210/60, 240/60. s.	d.	210/20. s.	d.	Country of Origin.
Gilbert & Co., Ltd.	13	6	14	6	United Kingdom
British Agencies, Ltd.	14	0	14	0	Switzerland
S.A. General Elec. Co.	11	0	11	0	U.S.A.
Niven & Mitchell	12	2	12	2	Austria
C. Kleudgen, Ltd.	12	0	12	0	Germany
Saaler & Franks, Ltd.	16	6	16	6	England
Griffin Eng. Co., Ltd.	13	2	14	2	England
Griffin Eng. Co., Ltd.	12	0	12	0	Germany
Siemens Bros. & Co., Ltd.	12	6	12	6	England
Reunert & Lenz, Ltd.	14	9	14	9	Holland
Rice, Wilson & Herd	11	0	11	0	England
Bartle & Co.	7	6	7	0	Austria
Metro-Vickers Elec. Co., Ltd.	11	5½	11	5½	England
B.G.E. Co., Ltd.	12	0	12	0	England
Hubert Davies & Co., Ltd.	12	4	12	4	Holland

"It is to be noted," says our contemporary, "that the lowest tender was 7s. 6d. and 7s. a dozen, the country of origin being Austria; further, that the lowest British offer was the same as the only American offer, namely, 11s. a dozen. It is evident that British manufacturers are up against severe competition."

Local Exhibition.—The Douglas (I.O.M.) Electrical Exhibition was opened by the Mayor (Councillor Kelly) on October 26th. It remains open until November 7th. Among the exhibitors are Messrs. Siemens Bros. & Co., Ltd., Carron Company, the General Electric Co., Ltd., R. Seddon & Sons, Lawton & Co., Christian & Shaw, J. C. Faragher & Co., T. W. Broadbent, and G. H. Blackburn. The exhibition, which is being held in the Royal Hall, is very comprehensive, every domestic application of electricity being represented, apart from numerous industrial appliances.

The Welsh National Museum.—The electrical installation at the National Museum of Wales, which was opened on Saturday, was carried out by Messrs. Fred Price & Co., Ltd., Cardiff. The fittings were especially designed to conform to the architectural design of the building, and much forethought was necessary in connection with the print galleries. The whole of the reflector glassware in the various galleries is of the "Moonstone" pattern, used in conjunction with the "Britannia" gasfilled lamps.

A German Review of Russian Electrical Prospects.—Some wholesome repression of the over-sanguine expectations regarding the rebuilding of Russia and the openings existing there for the electrical industry are furnished by Dr. M. Klein in a recent exhaustive study of that country's economic possibilities. On the development of Russia's water resources, he says there are existing some 20,000,000 h.p., 10,000 h.p. available in single installations, of which 2,500,000 h.p. takes first place for development. Bearing in mind that industrial Germany before the war had hardly 3,750,000 installed kW employed, it is difficult to see how Russia could utilise 2,500,000 h.p., for the creation of new industries there is still a question of the future. Besides this, the water power lies in regions which, on geographic or climatic grounds, makes the erection of big electrical works an impossibility. The Murman land, for instance, with its 1,000,000 h.p., lies north of the Polar circle and is, besides, thinly populated. The same criticism applies to Turkestan. There also the presumption of industrial development is lacking. The electrification of the railways is also out of the question, for the needed traffic is absent, one of the chief requirements in the economy of electric traffic. If, too, the circumstances in Germany and in Russia are compared (the data are taken mostly from the year 1910), it will be seen that, with a somewhat greater extent of network in the latter country, the passenger traffic is only one-tenth that of the German, and that from a square kilometre of land in Germany 150 times more goods are forwarded than in Russia. Lastly, if the huge wealth in timber in Russia be regarded, it is hard to see how electrical working can compete with the steam locomotive, which can obtain its fuel alongside the line on which it runs. More to the point, it would be, if the improvement of Russian navigation were taken in hand, for before the war more goods were forwarded by Russia's rivers than by its railways. One positive proposal Dr. Klein makes, at least, for the rebuilding of Russia, with the help of electricity. In the Ural, where most of Russia's industries are located, it would be possible to create a great timber trade. Side by side with this existing works must be improved and modernised. In such a development the electrotechnical industry would be afforded a rich field of working. Such industrialisation would, however, be quite upside down if begun by the building of power stations, because the Russian population would only be able to contribute to a feeble extent towards the large costs of such undertakings. The electrotechnical industry can only actively and usefully enter an appearance when production and traffic, whose servant it is, have reached a certain stage of progress.—*Elektrotechnik und Maschinenbau.*

Book Notices.—"The Metropolitan-Vickers Gazette," August and September.—The first of these two numbers contains papers and articles on "Electric Traction," by Sir V. L. Raven (reproduced); "Protective Apparatus for Turbo-Generators," by Mr. J. A. Kuyser (reproduced); "The Thermionic Valve," by Mr. H. C. McGuffie; "An Overload Inverse Time-Limit Relay with a Definite Adjustable Minimum"; "The Operating Time of D.C. Solenoids for Oil Circuit Breakers," by Mr. G. E. Gittins, B.Sc.; and a description of the plant extensions at Stoke-on-Trent.

The September number includes "Radio Broadcasting," by Mr. H. G. Bell, M.Sc.Tech.; "Modern Domestic Heating by Electricity," by Messrs. J. W. Buckley, M.Sc., and J. G. Pearce, B.Sc. (Eng.); "Post-war Electrical Driving Equipments in Lancashire Cotton-Spinning and Weaving Mills," by Mr. V. Mallalieu, and continuations of Sir V. L. Raven's and Mr. Kuyser's papers.

"Elevating and Conveying Machinery for Handling Loose Bulk Materials: Part II.—Conveyors," by H. Davies. London: Wightman & Co. (for the Association of Engineering and Shipbuilding Draughtsmen).—In this reprinted lecture belt conveyors of numerous types are fully described and formulæ for their design are given. Other types dealt with include tray, worm, and bucket conveyors.

"Hydro-Electric Engineering." Vol. II.—Electrical, by A. H. Gibson. Pp. viii+313; illustrated. London: Blackie and Son. Price 30s. net.

E.D.A. "Stunts."—An ingenious suggestion for solving that burning question of the day: "How to reduce the gas bill," is contained in the latest publication of the E.D.A. (No. 307). We recommend it to all electrical men who are endeavouring to increase their business, and it may also provide a way out of their dilemma for the gas companies.

Another device possessing topical interest is a leaflet (E.D.A. 327) in which the words "Conservative," "Liberal," and "Labour" are conspicuously brought out in a message urging the reader to "Vote for Electricity." Both these publications are extremely likely to "catch on" with the general public.

The Temporary Closing of Coventry Works.—At the meeting of the Coventry City Council, on Tuesday, the Mayor (Ald. W. H. Grant) reported upon an interview with the directors of the English Electric Co. with reference to the temporary closing of its works in the city. The result was that the directors expressed themselves as very sorry that they were not able to alter their decision. They explained they had, in addition to the Coventry works, other large undertakings at Rugby, Stafford, Bradford, and Preston fully equipped for dealing with the products they manufactured, and that these works had been for a considerable period on short time. The effect had been to materially increase the manufacturing costs, and they had, therefore, found it necessary to concentrate on those works which were best equipped for the company's specialities. The deputation was assured that the closing was merely temporary, and that as soon as conditions improved the works would be re-opened. It was not the intention of the company to remove or dismantle any of the plant, but to employ a very large number of the displaced men at the Rugby works.

Sheffield Steel Products Co., Ltd.—As the result of an inquiry into the financial position of the company, made by Messrs. W. B. Peat & Co., it was found that there was such a deficiency as to render continuation of the business impossible without reconstruction, which should produce further working capital. Sir W. B. Peat was last month appointed receiver and manager on behalf of the debenture holders, and proposals for reconstruction were to be prepared. On Tuesday last, however, a petition for compulsory liquidation by judgment creditors for £4,200 came before the Winding-up Court in London. It was then explained that the petition would stand over until next term.

Arbitration Failure in Australia.—The Sydney *Daily Mail* says that the annual report of the secretary of the Electrical Trades Union admits the inability of the present system of industrial arbitration "to provide for the realisation of the workers' social ideas." The system has already been condemned by a number of employers' federations.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British Trade marks in respect of goods and productions connected with the electrical trades and industries. Firms desiring to enter an objection to any of the applications have one month in which to do so from the dates mentioned below:—

L.P.C. Electrical Co. (lettering and design). No. 428,699. Class 5. Unwrought and partly-wrought metals used in manufacture. Jacob Lerman, trading as the L.P.S. Electrical Co., L.P.S. Works, Avenue Road, Acton, W. October 25th, 1922.

M.E.W. (lettering and design). No. 426,737. Class 8. Wireless communicating instruments and apparatus. Mitchells Electrical & Wireless, Ltd., McDermott Road, Peckham, S.E.15. October 25th, 1922.

Crystor. No. 427,369. Class 8. Apparatus for wireless telegraphy and telephony. Sydney L. Forbes, 5, Edwardes Place, Kensington, W.8. October 25th, 1922.

Bat. No. 428,448. Class 50. All kinds of insulating materials and preparations. Lindsay & Williams, Ltd. Bennett Street Works, Ardwick, Manchester. October 25th, 1922.

New Belgian Wireless Concern.—The Société Belge Radio-Electrique has been formed in Brussels with a share capital of 4,000,000 fr., and the participation of the Société Générale de Belgique and other banks.

The Brewers' Exhibition.—An outstanding feature of the 39th Brewers' Exhibition, held at the Agricultural Hall from October 28th to November 3rd, was the amount of electrically-driven machinery on show. The electrical resources of the hall must have been taxed to the limit. Apart from this, however, several firms displayed electrical appliances for various purposes, and we hope to say more about these in our next issue.

Chinese Notes.—The Electric Company of Harbin has been registered with the Ministry of Agriculture and Commerce.

The Kunshan Telephone Co., in Kunshan, Kiangsu, has petitioned the Ministry of Agriculture and Commerce for registration.

Negotiations between the Japanese and Chinese authorities concerning a scheme for transmission of electric power from Fushun to Moukden—first mooted in 1918—have been concluded, and surveys for the erection of cable standards across country were commenced in July; the work on this undertaking is nearly finished. The 1,500-kW extension to the plant of the Chinese Electric Light Co., at Moukden, contracted for by Messrs. Andersen, Meyer & Co., has been delivered during the year.

The Pin Kiang Electric Service Co., of Kirin, has been registered in the Ministry of Agriculture and Commerce.

The Hangchow Electric Light Co. is erecting outside the Ken Shan Men a large installation for the supply of electricity to the inhabitants of the Hangchow suburbs.

During February the new Soochow Electric light company began to operate, competing very successfully with the older company. It was rumoured that the new company obtained much support from those who had formerly patronised the old, or original, electric light company of Soochow, because, so it was contended, a good deal of Jananese money was invested in the old company.

South African Notes.—German magnetos have reappeared on the S.A. market, and are being freely advertised there. The summer spurt in the S.A. demand for electrical machinery and materials should last until the new year at least, as many municipal building schemes remain uncompleted. The recent installation of electric pumps for Elisabethville's water supply system provides an illustration of the growing Katanga market for electrical material.—*S.A. Engineer & Electrical Review.*

Peruvian Customs Exemptions.—It is reported from Lima that the President of the Republic has issued a decree exempting from import duties transport material (motor-cars, &c.), and telephone and telegraph material.

Ladies at Play.—We congratulate the Ediswan Ladies' Football Team on the capital start they have made for the new season. In the three games played to date they have proved victorious, their victims being Clapton, Osram, and East Ham. Their gaol total, 15 for, 2 against, speaks well for both their attack and defence.

Boiler Tools and Instruments.—The National Boiler and General Insurance Co., Ltd., has published a well-illustrated brochure setting out the equipment necessary for the satisfactory operation of boiler plant. The matter included comprises gauges, valves, scaling hammers, various testing instruments, indicators, and numerous other accessories.

New Italian Companies.—The Azienda Idroelettrica Giulia has been formed at Gorizia for the construction of hydro-electric plant and the generation and distribution of power in the communes and provinces of Gorizia and Trieste.

There has been formed at Rezzoaglio the Società Anonima Idroelettrica di Rezzoaglio, with a capital of 200,000 lire, for the establishment of a power station and the distribution of current in that city.

There has been embodied at Milan the Società Idroelettrica Alto Noce, with a capital of 100,000 lire, for the development of the water power of the River Noce and its feeders.

For Sale.—By direction of the Disposal Board, Messrs. Geering & Colyer will sell by auction at H.M. Dockyards, Chatham and Sheerness, on November 21st and following days, electrical plant and accessories. Holmfirth U.D.C. Electricity Department invites tenders for one 120-b.h.p. Bates and Scholes gas engine. (See our advertisement pages today.)

LIGHTING AND POWER NOTES.

Blackpool.—Electricity in Bulk.—The Electricity and Tramways Committee has received a letter from the Electricity Commissioners intimating that the Commission has asked the St. Annes Urban District Council to approach the Corporation with regard to the terms upon which it is prepared to give a bulk supply of electricity to meet the requirements of electricity consumers in the district of St. Annes and Lytham. A letter has also been received from the Clerk to the St. Annes Urban District Council inquiring the most favourable terms which the Corporation is prepared to offer for a bulk supply of electricity to the district. The communications have been referred to the chairman, the vice-chairman, and two members of the Electricity Committee with full authority to act and submit an offer to St. Annes.

Brighton.—New Plant.—The Town Council has decided to erect two water-tube boilers at the Southwick station at a cost of £22,066, and application is being made to the Electricity Commissioners for sanction to borrow that amount.

Buxton.—Loan.—The Town Council has decided to make application to the Electricity Commissioners for sanction to borrow £2,576 for the purchase of new plant.

Cardiff.—Reorganisation of Administration.—The Electricity and Tramways Committee has been divided into two committees dealing with electricity and tramways respectively, and all matters relating to public lighting will be dealt with by the Public Works Committee.

Chichester.—Electricity Supply.—A Special Electricity Order issued by the Electricity Commissioners on September 30th gives the Corporation power to supply electricity within the city and to a number of neighbouring parishes.

Chulmleigh (Devon).—Inauguration of Undertaking.—The chairman of the Parish Council recently set in motion the machinery at the new power station, which has been installed by local enterprise. Electricity is generated by water power and is distributed by overhead transmission lines.

Continental.—France.—The details of the agreement have been settled between France and Switzerland for the importation, by a 135,000-V transmission line, of electricity from the latter country into France. The line will start from Miécourt, in Switzerland, being linked to the network of the Berner Kraftwerke, which owns the station of Olten-Gosgen (Mühlberg). The power transported will be 28,000 kW. It will feed the Mulhouse district (the transformer station being situated at the Ile Napoléon), the districts of Colmar and Münster, and will be linked up at Wintzenheim-Turckheim to the existing 70,000-V transmission line belonging to the Société d'Electricité de Strasbourg. It will be continued to Sarrebourg-Creutzwald by a 70,000-V transmission line to Solec, now under construction, and belonging to the Société Alsacienne et Lorraine d'Electricité. Altogether the scheme represents the greatest interlinking of networks existing in France. The transformer stations required are not yet taken in hand, but will be so shortly. At the Ile Napoléon the 135,000-V transmission line will work in parallel with that from Laufenbourg at 70,000 V and that at Rheinfelden at 40,000 V. In the near future a station will be set up at Kembs, and probably a pumping station in the valley of Kaysersberg (Upper Rhine), the Commission du Rhin having agreed to the French utilising the waters of the Rhine.

Application has been made by the Société Hydro-électrique de la Tardoire for a concession to construct a network to serve some 13 communes in the *départements* of Charente and Dordogne.

The Société Agricole d'Electricité du Canton de la Ferté-Alais has applied for permission to set up a high- and low-pressure distribution system to serve 18 communes in the *département* of Seine-et-Oise. In the same *département* Government sanction has been asked for the establishment, by the Société Co-operative Agricole d'Electricité de Versailles Ouest, to distribute electricity to 12 communes in the Versailles region.

An extensive distribution scheme in the county bordering on the Upper and Lower Rhine is contemplated by the Electricité de Strasbourg company, which is applying for a concession to carry out the work.

In order to avoid a repetition of the troubles caused by the drought last year at its hydro-electric stations, the Société Sud Electrique is establishing a steam-operated sub-station near Nimes. The new plant will be of 3,000 h.p. and will be equipped with Thomson-Houston alternators.

Germany.—The production and consumption possibilities of the 100,000-V network of middle German were set forth at at recent meeting of the Elektrowerke Gesellschaft in Berlin. The network has a length of 1,500 km., and is thus half as big again as the projected 100,000-V network in Bavaria. The dynamo capacity linked up with the network amounts to some 700,000 kW. Various extensions both of the network and the generating plant are contemplated. By these installations the whole of the province of Brandenburg, including Berlin, the province of Saxony, and the Free States of Saxony and Anhalt, will be effectively supplied. Almost all of the above network has for some time been in parallel working.—*Elektrotechnik und Maschinenbau.*

Besides the big Bayernwerk scheme to develop the water resources of Bavaria on a large scale, a number of smaller schemes are in hand, including an installation on the Inn River, near Mühldorf, by the Innwerk-Bayrische Aluminium Gesellschaft. It is planned to give 100,000 h.p. A second is an installation on the Wagginger See in Upper Bavaria, calculated to yield a maximum of 7,000 h.p. A third is on the Main River near Oberwallenstadt, which will shortly be finished. Both these undertakings belong to the Munich Gesellschaft für Licht und Kraftversorgung.

Crieff.—Electricity Supply.—The Crieff Electric Supply Co. has been formed with a capital of £12,000, to supply electricity for lighting and power to the district.

Devizes.—Electricity Supply Scheme.—A strong syndicate of prominent local people has been formed with the view of establishing an electricity undertaking for Devizes and district, and Messrs. May & Hawes have been appointed consulting engineers to prepare a scheme for submission to the Electricity Commissioners with the syndicate's application for a Special Electricity Order.

Gillingham (Kent).—Extension of Supply.—A canvass is to be made of the residents in Wigmore and Hempstead with a view to extending the area of supply to include these districts.

Great Harwood.—Inauguration of Supply.—On October 27th the electricity supply was formally inaugurated by Councillor J. Bentley, J.P., chairman of the Council. Electricity is obtained from the Whitebirk generating station of Blackburn Corporation. Cables have already been laid in the main streets, and it is expected that the majority of the business premises will be supplied at an early date.

London.—Hammersmith.—The Electricity Committee recommends that a revision of prices be put into force as from the September meter readings. The proposals are broadly as follows:—Lighting: First 2,000 kWh per annum, 6d. per kWh; the charge will then be reduced by stages until a consumption of 20,000 kWh per annum is reached, when the charge will be 3d. per kWh. Power: First 2,000 kWh, 1.75d. per kWh; graduated reductions for larger quantities up to 14,000 kWh, after which the charge will be 1.4d. per kWh. Thermal storage supplies: 1½d. per day for each 100 W. Showroom supplies: Similar to power rates. Special rates for garages and kinemas. A special tariff is introduced for customers agreeing to take a minimum quantity for a year or for five years.

Stepney.—The Electricity Committee is adopting a "free" wiring system to small houses and tenements.

Malton.—New Power Station.—The Northern Electric Supply Co. has notified the Urban Council that in order to meet the increasing demands for electricity it has decided to erect a new power station.

Mansfield.—Extension of Supply.—The Town Council has decided to supply electricity to Pleasley Hill at a cost of £4,000.

New Zealand.—Hydro-Electric Progress.—A feature of the Public Works statement is that the total expenditure on the development of railways, roads, bridges, and hydro-electric installations exceeds that of the previous years by £3,000,000.

This is chiefly due to the installation of labour-saving machinery, which has reduced the cost of constructional earthworks by 30 per cent., and to additional work undertaken to prevent unemployment. Good progress is announced in all hydro-electric works, the contracts for the material for which have all been placed in Great Britain.—*Reuter* (Wellington).

Birkenhead.—The Borough Council of Birkenhead (N.Z.) is about to seek authority from the ratepayers to undertake a comprehensive scheme involving an expenditure of £98,500. Included in the project is a proposal to install electric lighting in the district.

Nanawatu-Oroua.—The Power Board in the Nanawatu-Oroua district (North Island) is shortly to take a poll for authority to raise £500,000 to provide for the reticulation of the local area electricity supply. About 700 miles of transmission lines and transformers, equipment, &c., would be required.

Wellington.—A report recently issued says that the City Council has for some time been faced with the question of the voltage which shall be used when the Government electricity supply is available. At present it is 100, but other places in the Dominion use 230. The difficulty is that a change will involve the alteration of all existing installations, which means an outlay of £750,000. To overcome this difficulty the Council's electrical engineer has proposed a voltage of 115, so designed as to be ultimately convertible to the 230 standard. Outside experts have been consulted, and they are unanimously in favour of a voltage of 230, which the Council has adopted, leaving the financial question to be adjusted later.

Auckland.—A schedule of electric street lighting to supplant the existing service has been adopted by the City Council. It is anticipated that the work will be completed by 1927, when the cost will reach £25,000 per annum.

As a result of an interview between representatives of the Auckland Electric Power Board and the Minister for Public Works, the Minister has undertaken to proceed at once with the erection of a transmission line from Horahora to Auckland.—*Reuter's Trade Service.*

North Wales and Chester Electricity District.—Inquiry Postponed.—With reference to the local inquiry with respect to the above-named district fixed for November 14th at the Assembly Room, Town Hall, Llandudno, the Electricity Commissioners feel that in view of the impending general election it would be in the interests of all parties to postpone the inquiry. They have accordingly decided to postpone the inquiry until Tuesday, November 21st. The time and place of the inquiry will remain unaltered.

Portsmouth.—Extension of Area.—The Electricity Commissioners have made a Special Order sanctioning the extension of the electricity supply area of the Corporation by the inclusion of the urban districts of Havant and Warblington, and the rural district of Havant.

Ripon.—Application for Order.—Application is being made for a Special Order to supply electricity within the city and in the surrounding district.

South Africa.—Electricity Commissioners.—The new Electricity Commissioners appointed under the Electricity Act are Sir Robert Kotzé, Mr. J. A. Vaughan, and Dr. H. J. van der Byl, the Industrial Adviser.—*S.A. Engineer and Electrical Review.*

Graaf-Reinet.—The municipalty is seeking the sanction of the Provincial Administration to borrow £57,000 for various town improvements, including a scheme for supplying the district with electricity.

Southwick.—Electricity Supply.—The Urban District Council has applied to the Electricity Commissioners for a Special Order, authorising it to generate and distribute electricity for public and private purposes within the district.

Sunderland.—Price Reductions.—The Electricity Committee has decided that the charges for electricity for lighting in shops, offices, theatres, private residences, and domestic premises be reduced by 10 per cent., as from the December readings of the meters.

Watford.—Extension of Supply.—The Urban Council has decided to supply electricity for public lighting to Hunton Bridge. The engineer has been instructed to report on the possibility of a reduction in the general tariff for electricity charges.

TRAMWAY AND RAILWAY NOTES.

Canada.—Ontario.—According to *The Times*, the Timiskaming and Northern Ontario Railway Commission recommends electrification of the provincial railway at a cost of $9,000,000 (£1,800,000).

Continental.—France.—The Orleans Railway Co. has for some time past had under consideration the possibility of utilising the water resources of the Central region of France to generate electricity to work the steep-gradient lines in the Montluçon district. The programme now in hand comprises the electrification of the Paris to Vierzon section (200 km.), with extensions later to Limoges and Brive, the electrification of these lines forming the first stage of the conversion of the great artery from Paris to Brive, Montauban, and Toulouse. The electrification of the Saint Sulpice to Gannat and the Brive to Clermont sections to assist the connection between Bordeaux and Lyons will be commenced about the same time. The Paris to Vierzon section will derive its electrical energy from the hydro-electric station at Eguzon, which is about to be built on the Creuse River and from the power stations in the Paris area. The Vierzon to Brive, the Saint Sulpice to Gannat, and the Brive to Clermont sections will derive their power from the groups of works in the Central region. Two of these works, Coindre and Cellette, are now in course of construction. These groups of hydraulic and power stations will be linked up by 150,000-V lines. The goods, passenger, and express trains will be drawn by electric locomotives similar to those in use on the Paris to Juvisy line, but more powerful. The completion of this first section of electrification will take from four to five years. The completion of the whole programme will extend over a period of about 20 years. Alternating current, three-phase, at 50 periods, will be used, transformed to continuous current at 1,500 V in sub-stations to be erected at various points.—*La Houille Blanche.*

Ilford.—Year's Working.—The report of the engineer and manager of the municipal tramway department (Mr. L. E. Harvey) for the year ended March 31st, 1922, shows that the total revenue was £79,838, as compared with £70,050 in the previous year. The working expenses amounted to £61,404, as against £61,871, leaving a gross surplus of £18,434 (£8,179). Capital charges absorbed £11,246, and £965 was credited as interest. The balance (net profit) of £8,153 was transferred to the reserve and depreciation account. This result shows favourably against a net deficit of £499 in 1920-21. £17,012 was spent on capital account, the bulk of this sum being devoted to the purchase of new cars. The car-mileage increased by 68,432 to 863,061, and the number of passengers carried by 867,984 to 11,299,254.

New Zealand.—Auckland.—The extension of the Auckland city tramway service along the Great South Road is to be put in hand early in January. The cost of the work, including equipment, will be approximately £75,000.—*Reuter's Trade Service* (Melbourne).

South Africa.—Railway Electrification Contracts.—In response to a question in the Union Legislature, Mr. J. W. Jagger, Minister of Railways and Harbours, recently gave some interesting and hitherto unpublished information regarding the tenders received by the Government for the electric locomotives required for the Pietermaritzburg-Glencoe section of the railway. It will be remembered that the successful tenderer was the Metropolitan-Vickers Electrical Co., Ltd., Manchester, which quoted £10,918 per engine. This firm sent in two tenders, the one accepted providing for the use of Swiss mechanical parts, and the other, providing for the use of all British parts, working out at £11,642 per engine. Other tenders received were from the English Electric Co., Ltd., London, £11,554; the Allgemeine Elektricitats Gesellschaft, £12,947; the Siemens-Schuckertwerke, £12,947; the International General Electric Co., £15,105; Sir W. G. Armstrong, Whitworth & Co., Ltd., £21,037; and Messrs. Brown, Boveri & Co., Switzerland, who sent in two tenders, one at £15,200 for all-Swiss locomotives exclusive of erection in South Africa, and the other at £11,650 providing for German electrical parts, and also exclusive of erection in South Africa.—*S.A. Engineer and Electrical Review.*

TELEGRAPH AND TELEPHONE NOTES.

Canada.—Telautograph Installation.—The Grand Trunk Railway Co. has installed in its Bonaventure station, Montreal, the telautograph system, by which handwriting is transmitted electrically over wires. The instruments in commercial use include a type by which messages may be either sent or received, another type which receives only, and additional equipment includes a selective switch key, by means of which a message written on a metal plate in an instrument used in sending, can be directed for written reproduction at any one or more of the receiving instruments used in the system, as desired. The exact handwriting of the sender is reproduced at the receiving instrument at the other end of the wire. The installation at Bonaventure is to provide the public with prompt information of train arrivals. The sending machine is located in the dispatcher's office, one receiving machine is in the station master's office, and another in the information bureau. The machines are operated on direct current. To transmit a message a special pen is connected to the transmitting machine by guide rods. As the message is written on the metal plate, every impression is exactly recorded in indelible ink, on a paper tape, in full view of the writer, and by a very fine adjustment of the current is faithfully reproduced in synchronism on the receiving machine paper tape.—*Canadian Railway and Marine World.*

India.—Wireless Telephony in Madras.—Seven sets of automatic wireless telephones for Malabar have been taken from Bombay to Malapuram. Major Benning, of the Marconi

Co.' in India, has also gone to Malabar from Bombay, and has had an interview with the Hon. A. R. Kapp, Special Commissioner for Malabar. He was to conduct a survey for the purpose of choosing the places at which installations are to be put up. The telephones were expected to be ready in October.—*Indian Engineering.*

South America.—Italian Cable.—It is reported from San Paulo that the subscriptions to the share capital of the Compagnia dei Cavi Sottomarini Italiani (Italian Submarine Cable Co.) in Argentina, Chile, Peru, Uruguay, &c., have already reached £1,000,000 sterling. This is equal to 25,000,000 gold lire, the Italian Government having agreed that sterling paper shall be considered as equal to 25 Italian lire. Landing rights at Rio de Janeiro and at Santos are said to have been obtained from the Government of Brazil.

The Telephone Service.—New Exchange.—The new Chorlton-cum-Hardy (Manchester) telephone exchange was opened on October 28th. There are 800 subscribers, with ample provision for extensions. The transfer to the new exchange will mean discarding the existing magneto system.

Wireless Telegraphy.—Rate Revision.—Marconi's Wireless Telegraph Co. states that from November 1st the rates for the ordinary and deferred half-rate services, "*via* Marconi," to all places in the United States of America, except New York City, will be amended by adding to the ordinary rate to New York City, which remains at 9d. per word, the respective landline charges to all points in the United States beyond New York City. The deferred rates are in all cases half the ordinary rates.—*Financier.*

Wireless Telephony.—Broadcasting Licences.—The regulations under which broadcasting licences will be issued are now complete. It is intended to supply every post office in the country, if possible, with licence form books by November 1st. Postmasters will issue them only for receiving stations in their own districts, and applicants who apply at other post offices than those in the district where the station is situated will be referred to the proper branch office. The particulars to be entered by the postmasters on the licences are: The name and address of the applicant, the address of the receiving station, and the date of expiry. The licences will be dated and initialled. Each will have a counterfoil, to be retained in the post office concerned. As regards dates of expiry, initial licences issued up to December 31st will expire on the following September 30th; those issued during the three months which ended on September 30th will fall due for renewal on June 30th next year, and those issued in the quarter which ended June 30th will become renewable on March 31st. In the second and subsequent years the renewal date for licences will be the anniversary of the date of expiry of the initial licence. No declarations of any kind will be required from the public. Notice to renew will be sent to the licensee ten days before the date of expiration, and the second notice four days after the date of expiration. If the licence is not renewed within ten days of the second notice the Post Office will take steps to inspect the station to see whether it is, *primâ facie*, still in use.—*Morning Post.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—November 10th. Electricity Department. One 10,000-kW turbo-alternator, with surface condenser and auxiliaries. (October 20th.)

Australia.—Melbourne.—Postmaster-General's Department. November 16th. Insulated signal cable (Sched. 958).
November 21st. Switchboard parts (Sched. 67).
December 12th. 1,416 switchboards (Sched. V68). October 20th.)
January 10th, 1923. Telegraph power plant (Sched. W.A. 647). (October 20th.)
Victorian Railways. November 29th. One industrial electric storage battery truck (4,000 lb. carrying capacity).*
January 24th, 1923. Fifty miles insulated copper wire.
January 19th, 1923. Electricity Commissioners. Steam turbine-driven boiler-feed pumps (Spec. 23/4) for the Morwell power scheme. (October 20th.)
January 15th. Switchgear and accessories, for the Morwell power scheme. (See this issue.)
January 26th. H.p. steam, drain and feed piping, valves, traps, &c. (See this issue.)
January 23rd. Melbourne Tramways Board. 500 kW rotary converter and a 550 kVA transformer.—*Reuter's Trade Service* (Melbourne).

Birmingham.—November 27th. Electric Supply Department. E.h.p. switch panels, &c. (October 20th.)

Bristol.—November 14th. Electricity Department. One 4,000-kVA single-phase turbo-alternator with condensing plant. (October 20th.)

Dublin.—November 14th. Irish Postmaster-General's Department. 90 tons h.d. copper wire, 25 tons bronze wire, 70 tons g.i. wire. (October 27th.)
November 13th. Great Northern Railway (Ireland). Stores for six months, including electrical fittings and lamps, electric cable and wire, &c. (October 27th.)

Dukinfield.—Stalybridge and Dukinfield Joint Sewerage Board. Electric motors and starters for the sewage disposal works, Bradley Hurst. Mr. F. Moss, clerk, Market Place, Ashton-under-Lyne.

Hull.—November 16th. Electricity Committee. Four natural-draught cooling towers. (See this issue.)

India.—November 17th. High Commissioner for India. D.c., l.p. two and three-core cables. (October 20th.)

Leeds.—November 10th. Electricity Department. Iron castings for 6 or 12 months. (October 20th.)

London.—St. Marylebone.—November 29th. Electricity Department. Turbo-alternator and condensing plant, water-tube boilers, fan-draught water-cooling tower, and rotary converter plant. (See this issue.)

Maidstone.—November 8th. Board of Guardians. Internal telephone system, Coxheath Institution. Mr. F. Post, clerk, King Street.

New Zealand. — Wellington.—December 5th. Public Works Tender Board. Telephone system for the Mangahao power house and sub-stations, &c.*
January 9th, 1923. Five sets 11,000-V sub-station switchgear, for the Mangahao power scheme.*
January 9th, 1923. Two sets 11,000-V sub-station switchgear, for the Lake Coleridge power scheme.*
Dunedin.—December 8th. City Council. One 150-h.p. 3-phase motor and reduction gear for the Mornington cable tramway system.*

South Africa. —Pretoria. —November 23rd. Municipal Council. H.p. and l.p. switchgear, transformers, and cables in connection with the extension of the electric light and power supply.*

South Shields.—November 15th. Electricity Department. Two water-tube boilers with mechanical stokers, economisers, induced draught plant, and steel chimney, also ash-handling plant and extension to boiler-house. (October 20th.)

Spain.—November 10th. The Harbour Works authorities at Valencia. Three electrically-operated cranes.

Stoke-on-Trent.—November 15th. Electricity Department. Mains and cables for 12 months. (October 27th.)

Warrington.—November 13th. Electricity Department. H. and l.p. paper and lead-covered cable. (October 20th.)

York.—November 21st. North-Eastern Railway Co. Telegraph apparatus and telegraph wire and line stores for six months. (October 27th.)

*A copy of the plan, specification, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Brighton.—Corporation. Accepted:—
Boilers required for the electricity works extension.—Yarrow & Co. (1922), Ltd.

Government Contracts.—The following Government contracts were placed during September, 1922:—

Admiralty (Contract and Purchase Department).
Secondary cells.—Fuller's United Electric Works, Ltd.
Electric lighting and power wiring.—G. E. Taylor & Co.
Electrodes.—Quasi-Arc Co., Ltd.
Electric fuses.—L. Weekes, Ltd.
Motor-driven special-type lathe.—J. Holroyd & Co., Ltd.
Electrically-driven oval-hole cutting machine.—Scriven & Co., Ltd.
Motor-driven milling and drilling machine.—H. W. Kearns & Co., Ltd.
Electric seam-welding plant.—British Insulated & Helsby Cables, Ltd.
Platinum.—Johnson, Matthey & Co., Ltd.
Automatic telephone equipment.—Relay Automatic Telephone Co., Ltd.

War Office.
Carbons.—General Electric Co., Ltd.
Electric wire.—Enfield Ediswan Cable Works, Ltd.

Air Ministry.
Accumulators.—Chloride Electrical Storage Co., Ltd.; Peto & Radford, Ltd.
Electrical wires and cables.—Hooper's Telegraph & India Rubber Works, Ltd.; General Electric Co., Ltd.; W. T. Glover & Co., Ltd.; Macintosh Cable Co., Ltd.; Enfield Ediswan Cable Works, Ltd.
Direction-finding stations.—Marconi Wireless Telegraph Co., Ltd.
Magnetos.—British Thomson-Houston Co., Ltd.

Crown Agents for the Colonies.
Cable.—W. T. Henley's Telegraph Works Co., Ltd.
Electric light poles.—Bullers, Ltd.
Telephone switchboard, &c.—Relay Automatic Telephone Co., Ltd.
Wireless apparatus.—Radio Communications Co., Ltd.
X-ray apparatus.—Watson & Sons (Electro-Medical), Ltd.

Post Office.
Manufacture, supply, drawing-in and jointing cable (Bradford, Haworth, Cullingworth, &c.).—Western Electric Co., Ltd.
Racks and telephone repeaters (Taplow telephonic repeater station).—General Electric Co., Ltd.
Telephone exchange equipment: Birkenhead.—British L. M. Ericsson Manufacturing Co., Ltd. Sub-contractors: (for batteries), D. P. Battery Co., Ltd.; (for motor generators), Crompton & Co.
Creed apparatus.—Creed & Co., Ltd.

Telephone apparatus.—British L. M. Ericsson Manufacturing Co.. Ltd.; Phœnix Telephone & Electric Works, Ltd.
Testing, protective apparatus, &c.—Automatic Telephone Manufacturing Co., Ltd.; British L. M. Ericsson Manufacturing Co., Ltd.
Terminal blocks.—Electric & Ordnance Accessories, Ltd.
Submarine cable.—W. T. Henley's Telegraph Works Co., Ltd.
Telegraph and telephone cable.—British Insulated & Helsby Cables, Ltd.; Enfield Ediswan Cable Works, Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.
Leclanché porous cells.—General Electric Co., Ltd.
Stationary secondary cells.—Accumulators of Woking, Ltd.; Van Raden and Co., Ltd.
Ducts.—Doulton & Co., Ltd.; Hepworth Iron Co., Ltd.; Oates & Green, Ltd.; Robinson & Dowler, Ltd.
Glow lamps.—Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.
Tungsten lamps.—British Thomson-Houston Co., Ltd.; Edison Swan Electric Co., Ltd.; English Electric & Siemens Supplies, Ltd.; General Electric Co., Ltd.
Lead strip and sheet.—Walkers, Parker & Co.
Electric motors.—General Electric Co., Ltd.
Mouthpieces, No. 1.—North British Rubber Co., Ltd.
Distribution cable plugs.—British Insulated & Helsby Cables, Ltd.; Siemens Bros. & Co., Ltd.
Creosoted wood troughing.—Calder & McDougall, Ltd.
Insulated copper wire.—W. Geipel & Co., Ltd.
Leclanché zinc rods.—Locke, Lancaster and W. W. & R. Johnson & Sons, Ltd.

H.M. OFFICE OF WORKS.

Engineering works: Supply of engineering labour (Cardiff district)).—Alpha Manufacturing Co. Electric wiring Cornwall House.—A. F. Goodwin & Co.

Maidstone.—Town Council. Accepted:—
Feeder cable (£544).—Union Cable Co.

Manchester.—Tramways Committee. Accepted.
Stores for six months.
Assembled commutator segments.—Dyer & Young; Manchester Armature Repair Co., Ltd.; Met.-Vickers Elecl. Co., Ltd.
Armature coils and equipments.—Manchester Armature Repair Co., Ltd.
Bell presses.—Met.-Vickers Elecl. Co., Ltd.
Phosphor-bronze springs, worm spindles and bushes, two-way connectors, trolley wheel bushes.—Kay & Co.
Tension springs.—British Thomson-Houston Co., Ltd.
Insulation tape, &c.—L. Andrew & Co.; Connolly Bros.
Controller fingers, &c.—Fairless Eng. Supplies Co., Ltd.
Steel conduit tubing, &c.—Perfecta Seamless Steel Tube & Conduit Co., Ltd.
Incandescent lamps.—Drake & Gorham (Wholesale), Ltd.
Switches and sundry lighting material.—General Electric Co., Ltd.
Electric bells, &c.—Mason & Brown.
Cells for bell circuits.—Edison Swan Elec. Co., Ltd.
Mica cones, micanite washers.—R. Whiffen, Ltd.
Insulation cloth, carbon brushes.—Hamnett & Andrew.
Divisions for arc deflectors.—British Thomson-Houston Co., Ltd.; Siluminite Insulator Co., Ltd.
Insulation varnish, &c.—Griffiths Bros. & Co. (London), Ltd.
Soldering fluid and Chatterton compound.—Ward & Goldstone.
Overhead line material.—A. Wiseman, Ltd.
Trolley poles.—Equipment & Engineering Co.
Trolley wheel bushes, &c.—Tramway Supplies, Ltd.
Trolley wheel spindles.—Tramway Supplies, Ltd.; Marshall, Osborn and Co.
Shoes for electro-mechanical brakes, grid resistances.—Electro-Mechanical Brake Co., Ltd.
Magnet coils for E.M. brakes.—P. R. Jackson & Co., Ltd.
Bell crank levers, brackets for E.M. brakes.—J. Mountford & Co., Ltd.
Grids for resistances.—H. Wallwork & Co., Ltd.
Power and lighting cables.—British Insulated & Helsby Cables, Ltd.
Copper cable and strip and steel wire.—F. Smith & Co., Ltd.
Galvanised steel cable.—R. Johnson & Nephew, Ltd.
Celluloid sheets.—Spicers, Ltd.

Education Committee. Accepted:—
Installation of electric lighting at Heald Place Temporary Municipal School.—Ward & Booth.
Electric lamps for schools.—G. H. W. Gasper.

South Africa.—Electrification of the Glencoe-Pietermaritzburg section of the South African Railways. Machinery for sub-stations:—
Twenty-one 2,000-kW motor-generator sets for 3,000-V, d.c. service, with switchgear, automatic control gear, auxiliary transformers, &c., £400,000 (approximately).—British Thomson-Houston Co., Ltd.

Stirlingshire.—Town Council of Denny and Dunipace. Accepted:—
Herbertshire Street extension of the electric cable.—Harland Engineering Co., Ltd.

Watford.—Corporation. Accepted:—
Two water-tube boilers of 30,000 lb. capacity each.—The Spearing Boiler Co., Ltd.

FORTHCOMING EVENTS.

Finsbury Technical College Old Students' Association.—Saturday, November 4th. At the Engineers' Club, London. Annual dinner.

Salford Technical and Engineering Association.—Saturday, November 4th. At the Royal Technical College. At 6.30 p.m. Short papers by members.

Institute of Transport.—Monday, November 6th. At the Institution of Electrical Engineers, Victoria Embankment. At 5.30 p.m. Paper on "British Railway Operating Statistics and Their Lessons," by Sir W. Acworth.

Institution of Electrical Engineers.—Informal meeting. Monday, November 6th. At the Institution, Victoria Embankment. At 7 p.m. Discussion on "The Importance of Commercial Knowledge to the Engineer," to be opened by the President, Mr. F. Gill.

(Western Centre).—Monday, November 6th. At the South Wales Institute of Engineers, Cardiff. At 6 p.m. Paper on "The Interconnection of a.c. Power Stations," by Mr. J. B. Palmer and Mr. L. Romero.

(Liverpool Sub-Centre).—Monday, November 6th. At the Liverpool University. At 7 p.m. Chairman's (Mr. B. Welbourn) address.

(North-Midland Centre).—Tuesday, November 7th. At the Hotel Metropole, Leeds. At 6.45 p.m. Inaugural address by the Chairman, Mr. W. B. Woodhouse, and smoking concert.

(Wireless Section).—Wednesday, November 8th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "The Effect of Local Conditions on Radio Direction-finding Installations," by Mr. R. L. Smith-Rose and Mr. R. H. Barfield.

Royal Institution of Great Britain.—Monday, November 6th. At Albemarle Street, W. At 5 p.m. General meeting.

Society of Engineers.—Monday, November 6th. At Burlington House, W. At 5.30 p.m. Paper on "The Atlantic Cruise of H.M. Airship R.34," by Mr. E. E. Turner.

Rontgen Society.—Tuesday, November 7th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 8.15 p.m. Presidential address by Sir H. D. Rolleston on "Acute Constitutional Symptoms Due to Radiations."

Institution of Civil Engineers.—Tuesday, November 7th. At the Institution Great George Street, S.W. At 6 p.m. Address by the President, Dr. W. H. Maw, and presentation of medals awarded by the Council.

Electrical Society of Glasgow.—Tuesday, November 7th. At Glasgow. Paper on "Application of Electricity to Domestic Purposes," by Mr. H. L. K. Johnson.

Royal Society of Arts.—Wednesday, November 8th. At John Street, Adelphi, W.C. At 8 p.m. Inaugural address by the Chairman, Lord Askwith, on "The Value of Strikes and Lock-outs."

Nottingham Society of Engineers.—Wednesday, November 8th. At the Welbeck Hotel. At 7.30 p.m. Paper on "Spinning Tops and Gyroscopic Motion," by Mr. L. C. Perkin.

Chelmsford Engineering Society.—Thursday, November 9th. At the East Anglian Institute of Agriculture. At 7 p.m. Demonstration of Wireless Telephony, by Mr. C. H. Ford.

Optical Society.—Thursday, November 9th. At the Imperial College of Science, South Kensington. At 7.30 p.m. Lecture on "The History of the Photographic Lens," by Dr. R. S. Clay.

Physical Society of London.—Friday, November 10th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting.

Junior Institution of Engineers.—Friday, November 10th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "The Development of Ball and Roller Bearings," by Mr. A. Macaulay.

Edinburgh Electrical Society.—Friday, November 10th. At the Philosophical Institute. At 8 p.m. Paper on "Scientific Illumination," by Mr. E. J. Taylor.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete replies to queries received this week we need the names of manufacturers or suppliers of:—

Electrical heating apparatus which would light oil-fired furnaces. The lighter would have to be left in the furnace for about five minutes.

NOTES.

British and Best.—In answer to questions, the Dutch Navy Minister has stated that the stipulation that certain parts of a new cable ship must be of British make was inserted because British marine engineering work had proved during many years more reliable than Dutch. British industry owes its thanks for this striking and unsolicited testimonial. We ask for nothing better than the candid admission that best is not only best, but British.—*Evening News.*

The Juvenile in Industry.—Mr. Robert Hyde, the director of the Industrial Welfare Society, read a paper on "The Juvenile in Industry" at a conference held at the Witton works of the General Electric Co. on Saturday last. Mr. Hyde urged that the boy entering industry should be treated as a boy and not as a man; he should not be expected to "pick up" knowledge. Inquiries in which 100,000 boys were involved showed that only in the case of less than 40 per cent. was suitable training being provided. Employers should make sure that no boy was given work for which he was not physically fit, provision for recreation should be made, and the working conditions should be conducive to good health.

The Electrification of German Railways.—Herr Groener, the Minister for the Reich railways, was recently interviewed by a representative of a Stuttgart newspaper on this subject. The Minister is reported to have stated that the State railways, which are dependent upon pit coal for steam locomotion and which require one-tenth of the total consumption of coal in Germany, must not shrink from passing over to other forms of working. In this connection electricity was specially concerned where it could be produced from inferior fuels and water power. In North and Central Germany it was particularly the lignite mines in which electricity could be produced through combustion or gasification; while in South Germany the large hydro-electric works were to be utilised for the purpose. Notwithstanding the difficult financial situation, the Minister stated that he had resolved to promote the transition to electrical working with all energy. The States in the South West—Wurtemberg and Baden—also must introduce electrical working on their main lines as soon as possible, as, for instance, from Basle to Frankfort-on-Main and from Carlsruhe *via* Stuttgart to Ulm. The lines in the Black Forest, of course, would likewise be electrified. In conclusion, the Minister stated that he hoped for the vital participation and support of the Federal States, especially in so far as they possess water power, and he also reckoned on their co-operation in his efforts to render available for the electrification of the Reich railways, the still slumbering water power of the Rhine, the Main, and the Neckar, as well as of the Danube, without having regard to the Federal State frontiers.

Wireless Exhibition.—CORRECTION.—In our description of the exhibits at the above-named show, the word "Automatic" was included in the name of the Telephone Manufacturing Co., Ltd.—an unfortunate slip which we hope has not been the cause of any misunderstanding.

Tramway Authorities and Road Maintenance.—The General Purposes Committee of the L.C.C., in the course of observations upon the second interim report of the Departmental Committee appointed by the Ministry of Transport to investigate certain matters with regard to the taxation of road vehicles, states that "tramway authorities who are compelled to maintain that portion of the road over which the cars travel should be afforded financial assistance from the Road Fund, having regard to the increased wear and tear to which such portion of the road is subjected by the extended use of both heavy and fast-moving motor vehicles."

Pulverised Fuel in the United States.—The new Cahokia plant of the Union Electric Light & Power Co. in St. Louis will have its initial installation of eight boilers equipped with pulverised-fuel apparatus.

The reasons given by Messrs. McClellan & Junkersfeld, consulting electrical engineers, for the use of this fuel are:—

1.—An annual coal consumption lower than with the best of a number of stokers tested and investigated is assured.

2.—A net saving is made in operating cost by reason of the relative cost of maintenance, banking and pick-up losses, ash disposal and pay-roll.

3.—Increased operating convenience is gained both for normal load and for quickly added loads.

4.—The fixed charges on pulverised-fuel equipment and buildings are no greater than those on stoker equipment and buildings.

5.—Owing to the location of the plant, there is no question of trouble from stack ash.

6.—Operating reliability of the equipment is unquestionable, while low-grade fuel can be burned and oil can be quickly substituted for coal if desired.

The increased efficiency of combustion with the use of pulverised fuel was the biggest of several factors. Moreover, this plant is about 20 miles from a mining region where low-grade fuel can be obtained at about $2.50 per ton. In the opinion of Mr. P. Junkersfeld, slagging and troubles with pulverised fuel are as preventable as with stokers and have been eliminated to a large extent by careful design.

The decision on the plant fuel equipment was reached only after exhaustive tests and investigations had been made. The new plant will cost about $6,000,000 and will be built on the Illinois side of the Mississippi at St. Louis. At present there are being installed two 30,000-kW turbo-generators, but the ultimate development will consists of eight sets. The two sets are supplied with steam from eight boilers of about 18,000 sq. ft. heating surface with a steam pressure at the throttle of 300 lb. at a temperature of 690 deg. F.

The boilers will be without economisers and will be eighteen or twenty tubes high, with a very deep combustion chamber specially designed to burn puverised fuel having about 17 per cent. ash content. The pulverised-fuel equipment is part of the boiler, takes the same space and is arranged like a stoker installation, as part of the boiler room.

Following a successful experiment in operating a power plant with powdered coal as fuel, the Arkansas Light and Power Co. plans to install a large plant of this type at Russellville, Ark. The powdered-coal plant, which was installed as an experiment, is declared to be a complete success.—*Electrical World*.

First Mercury Boiler and Turbine.—The first commercial mercury boiler and turbine in the world will shortly be shipped from the Schenectady works of the General Electric Co., and will be installed at the Dutch Point generating station of the Hartford (Conn.) Electric Light Co. The mercury turbine is of about 2,000-kVA capacity, and every facility will be provided for analysing its performance. Fuel oil will be burned and will be weighed instead of measured; recording instruments will be installed to enable the energy consumption of auxiliaries to be studied, and feed water and other items will be measured. The equipment will be housed in a 26 ft. by 45 ft. structure. It is hoped to cut down the fuel consumption per kilowatt-hour by approximately 50 per cent. by the use of the mercury turbine and utilisation in steam production of heat given up in the mercury condensation process. The general arrangement of the apparatus is to install a 2,000-kVA mercury turbo-generator on the top of an oil-fired mercury boiler containing about 30,000 lb. of mercury. The mercury vapour at rather low pressure operates the turbine. The exhaust from the turbine produces steam in a modified water boiler which will be introduced into the steam lines of the plant. Mr. W. L. R. Emmet has devoted years to the development of the mercury boiler and turbine.—*South Africa Engineer and Electrical Review*.

Wireless Manufacturers and Traders' Association of Great Britain.—This recently-formed Association has a Northern and a Southern Section, and is particularly concerned, at present, with the conditions of membership of the British Broadcasting Co. It is endeavouring to associate the "outside" manufacturers and traders in a common effort to secure that the two persons to be elected to the board of the B.B. Co., outside those of the "big six" which have promoted it, shall be truly representatives of the radio apparatus manufacturers and traders of the country. Its objects are (briefly): To protect and further the interests of all engaged *bona fide* in the wireless industry; to prevent the establishment of a monopoly; and to maintain the free and unfettered right of all to trade without hindrance. The Association will also give commercial services, and is to be registered as a limited company (by guarantee). Members will thus be protected from individual liability. The central office of the Association will be situate in London, and membership will be open to all manufacturers of, or traders in, wireless instruments, parts or materials, or persons otherwise engaged in the wireless industry in Great Britain. The annual subscription is £2 2s., or such other amount as shall be, after the first annual subscription, decided upon. The objects of the Association are (*inter alia*):

(i) To protect the interests of manufacturers and traders from onerous or restrictive legislation, and to make recommendations to the competent authorities whenever necessary for this purpose;

(ii) To protect the interests of manufacturers of wireless instruments and component parts, traders in wireless instruments, parts or materials, and other persons engaged in the wireless industry;

(iii) To provide, wherever possible and desired, expert technical advice for members;

(iv) To protect members by the provision of expert legal and technical advice on questions of patents, infringements, and licences;

(v) To establish relations and to co-operate with kindred associations in this and other countries;

(vi) To act as a bureau and a central source of information on all trade, financial and commercial matters, and to provide status reports and such like services.

National Association of Supervising Electricians.—The visit of the Association to the Lots Road power station on October 23rd was a decided success. The party, which included Mr. W. E. Highfield, the president of the Association, numbered over 60, and, under the guidance of Mr. T. D. Grant, of the power station, the party spent the greater part of the afternoon inspecting the plant. The visit was of a most interesting and instructive character, and was fully appreciated by all who took part in it.

Electric Grillers on Liners.—The Cunard liner *Aquitania* contains electric grills capable of dealing with some 400 chops or steaks every hour. On all its vessels, the Cunard Co. has electric toasters. They are in the kitchens and pantries, and amongst many machines deriving their power from electric motors may be mentioned potato peelers, dish-washing machines, which eliminate unnecessary handling and smashing of crockery, mincing, and slicing machines. An apparatus which greatly interests visitors to the kitchens and bakeries on these vessels is the new "human hand" dough-making machine, which is said to reproduce the action of the baker's hand and arm in mixing the dough.

Electric Steel.—The *Iron and Coal Trades Review* recently gave statistics showing the growth of electrically-produced steel. Prior to 1913 steel produced in this way was practically unknown, but in that year a total of 168,673 tons was made—Germany accounting for about half of this, 88,256 tons. Returns from Germany and Austria were not available after the war, but, excluding these countries, the 1920 production had reached 777,633 tons, the principal contributors being the United States (502,152), Italy (100,000), and Great Britain (89,000). In 1921 there was a serious decline, the total being 377,900 tons, of which the United States produced 169,450, Great Britain, 27,100, and Italy, 140,000 tons.

An All-Electric Country.—Some interesting figures showing the extent to which electricity is used in the United States were given in a recent issue of the *National Electragist*, the organ of the American contractor-dealers. Recently-compiled statistics show that more than one-third of the homes in the United States are wired for electricity. Of the 21,145,126 houses, 7,636,409 are wired for electric service, while 5,363,531 are not wired, but could be connected to existing distribution lines. The homes unwired and not yet reached by distribution lines number 8,145,000. There are about 140,000 electric ranges in use in the United States to-day. In 1915 there were 10,000. Last year 30,000 were installed, and it is predicted that this year 100,000 will be sold.

Appointments Vacant.—Shift engineer for the Ipswich Corporation Electricity Supply and Tramway Department; plumber-jointer for the Harrogate Corporation Electricity Department; plumber-jointer for the Nelson Corporation Electricity Department. (See our advertisement pages.)

Educational.—University of London: University College.—The Calendar for the 1922-23 session has been published, giving full particulars of departments, staff, courses, prizes, and scholarships, &c. In addition to this, there are lists of successes in the several faculties, a roll of Fellows, and a mass of other information of a varied character.

South Africa.—A portion of the new Cape Technical College was opened on October 7th, following upon the closing of the Salt River Technical Institute. £10,000 has recently been voted by the Union Government towards equipment, and it is expected that an official opening ceremony will take place next year.

The New President: A Correction.—We regret that in our article on the career of Mr. Frank Gill, President I.E.E., last week an error occurred in respect of his present position, which should be described as "European engineer-in-chief to the International Western Electric Co."

Automatic Train Control.—The case for automatic train control receives further support in Major G. L. Hall's report to the Ministry of Transport upon the accident near Gravesend in August last, in which five men were killed and 17 injured, apart from shock and minor injuries in other cases. Major Hall lays the primary responsibility for the mishap upon the driver of the train which was run into by a light engine, stating that only a perfunctory observation of the signal could have been made. Blame is also attached in a less degree to the fireman, and to a signalman who pulled off the platform starting signal before the second train arrived, the section ahead being still occupied. Major Hall concludes his report as follows:—"The case is a typical example of the class of accident preventable by automatic train control in the form of a definite train stop at the signal concerned; upon obedience to which, governing as it does the admission of a train to the section ahead, the security of the absolute block system largely depends."

Gas on Trains.—Last Saturday an accident occurred on one of the Paris suburban railways, in a tunnel, three coaches being derailed; the gas reservoirs of an overturned coach were ruptured, and the wreck was quickly set ablaze. Fortunately the passengers were able to escape, those who were pinned by broken timbers being rescued before the flames reached them.

Electric Ship Propulsion.—In the course of a paper on the subject of ship propulsion, before the North-Eastern Section of the Junior Institution of Engineers, at Newcastle-on-Tyne, Mr. J. Calderwood said: Electrical methods of speed reduction for turbines are in successful operation. Although it is sometimes strongly advocated, electric drive with internal-combustion engines does not seem to be at all suitable for the propulsion of a ship, except, possibly, for services of a very unusual kind (such, for example, as cable steamers, where the ship has often to run at a speed of from ½ to 2 knots for a considerable length of time). In such a case the adoption of oil engines with electric drive would show great advantages in economy, as a large engine running very slowly is exceedingly inefficient, whereas with electric drive, three generators might be supplied, one of which could alone take the whole load of ship propulsion, an electric cable engine, and electric auxiliaries when laying cables, and when running at full speed all three generators could be in use. Such a system would, of course, require direct-current generators and variable-speed motors. For all ordinary services, the direct-connected oil engine shows great advantages over the electric drive, except possibly in the matter of weight, and in this respect it does not appear that there will be much difference between the two systems of propulsion. The main disadvantage of the electric drive is that, in order to reduce weight, high-speed oil engines are used. The high-speed oil engine, when mounted on a solid concrete base, is a very reliable and good power producer, but when mounted in an exceedingly flexible structure, such as a ship, the case is very different. The vibration from a comparatively small high-speed engine is very unpleasant, and when several such engines of large size are running together—probably, too, at slightly different speeds—the vibration would, it is to be feared, be very bad, and would almost certainly make the engines themselves unreliable and cause defects in the ship's structure.

The turbine electric drive appears to be able to justify itself to a greater extent than can the oil engine electric drive, but even in this case it can show no real advantage over the geared turbine, while the greater complication must increase both first cost and running cost; and its adoption can only be justified in the case of special types of turbine, such as the Ljungström, which are not suitable for a mechanical drive, but which show such high efficiencies as to make their adoption desirable from the point of view of fuel economy. With a turbo-electric drive alternating current must be used, due to the high speed most suitable for the turbines; this makes a variable-speed motor impossible (unless more than one field winding is used, which can give two or more definite speeds) and speed variation must be obtained by variation of the generator speed, which takes from the electric drive one of its main advantages, namely, the possibility of constant-speed generators and control of the ship's speed by alteration of the motor speed.

As a result of troubles with steam deck machinery, electric winches, capstans, &c., are coming into more common use and, though the majority of sea-going engineers seem to have an intense dislike of electrical machinery in the engine-room, there are few who would not be very thankful for the substitution of electricity for steam on deck.

The engine-room auxiliaries vary, of course, with the type of main machinery installed.

The installation of electric auxiliaries is now becoming common, particularly in the case of oil-engined vessels, as with them the presence of a donkey boiler to supply steam to the auxiliaries adds to both weight and cost of the machinery. The generators in such ships are usually oil-engine driven. When electric auxiliaries are used on a steam installation, the generator is driven either by a high-speed steam engine or by a small geared turbine; the latter makes a much neater job, but is often objectionable because of the noise always made by small turbines which run at a very high speed.

It has been usual up to the present to fit direct-current generators and motors, but alternating current would seem to be preferable from many points of view; an induction motor is much more reliable in the hands of engineers not thoroughly conversant with electricity than is a direct-current motor, with its commutator, brushes, &c. Alternating current is also desirable from the point of view of economy in first cost, as both generators and motors are much cheaper than those of the direct-current type. Electric auxiliaries do not, as is generally supposed, make any great saving in steam consumption, their advantage being principally reliability and simplicity of operation. As the driving of reciprocating pumps through gears by an electric motor is not a particularly nice arrangement, the use of centrifugal pumps for all purposes is becoming more common, but there is still much to be known of these pumps before they can be adopted with safety. It is, therefore, usual to supply steam stand-by pumps, in case the electrically-driven centrifugal pumps fail to perform as they should when unfavourable conditions arise.

A Sound Election "Slogan."—"Electric light for every householder!" is one of the election cries of the Labour candidates at the municipal elections in Poplar.—*Evening News.*

A Large Colliery Winder.—Correction.—In our note on this subject, on p. 562 of our issue of October 20th, the motor was referred to as a synchronous induction motor; this type is obviously unsuitable for winding-engine service, and the word "synchronous" should have been omitted.

Correct Industrial Illumination.—The accompanying illustration is a reproduction of an actual unretouched night photograph of a very successful installation of Benjamin reflectors recently completed. It represents the raw materials stores at the new factory at Willesden erected for Messrs. Studebaker, Ltd., the manufacturers of the well-known automobile of that name. The absence of both glare and objectionable shadows will be apparent, the result being practically equivalent to daylight intensity. Messrs. Benjamin Electric, Ltd.'s R.L.M. dispersive reflectors were mainly employed with 300-watt gasfilled lamps, while in the main bay of the shops concentrative reflectors were used with 500-watt gasfilled lamps.

Correct Industrial Illumination.

Miners' Lamps.—The inquiry into the explosion at Haig Pit, Whitehaven, Cumberland, on September 5th, when 39 miners lost their lives, was opened on October 9th. Mr. Alexander Miller, the under-manager, cross-examined by Mr. H. Smith, acting president of the Miners' Federation, agreed that since the accident he had come to the conclusion that it would be a good thing to supply every miner with a flame safety lamp. Mr. Smith quoted the regulation which provides that every workman at the face of the coal shall carefully examine the place before starting work, and asked how the miners could do that if they had no flame safety lamp. A miner could not examine for gas with an electric lamp. Mr. Miller replied that if a miner had any fear of gas he had only to call one of the deputies to examine the place for him. Every miner had an electric lamp. Mr. Smith: You admit, then, that you failed to carry out this clause?—Mr. Miller: The deputy could always have been called. Questioned by Mr. F. A. Macquisten, K.C., M.P., who appeared for the colliery company, Mr. Miller considered that oil lamps were more dangerous than electric lamps.—*Daily Mail.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—East Midland Sub-Centre.—The following are the subjects of the meetings being held during the 1922-23 session:—November 21st, "Some Recent Research in Electrical Engineering," by Prof. W. Cramp, D.Sc.; December 12th, short papers by Students of the Institution; January 9th, 1923, "Starters and Controllers for Electric Motors," by Mr.

O. C. Dinerman; January 30th, "The Transmission of Power by Underground Cables at 100,000/150,000 volts," by Major A. M. Taylor; February 20th, short papers, arranged by Mr. C. Sutton; March 13th, "Automatic Telephones," by Mr. E. A. Laidlaw; April 10th, "Problems of High-Speed Alternators and their Solution," by Mr. J. Rosen; May 1st, "An Electric Harmonic Analyser," by Prof. Miles Walker, D.Sc.

South Midland Centre.—The annual dinner will be held at the Grand Hotel on November 24th. The following gentlemen have already definitely promised to attend and take part in the proceedings: Mr. F. Gill, O.B.E. (President I.E.E.); the Lord Mayor of Birmingham (Alderman David Davis); the Rt. Hon. Austen Chamberlain, M.P.; the Principal of Birmingham University (Mr. W. Grant Robertson, M.A., C.V.O.); Mr. Neville Chamberlain, M.P.; Mr. Hugo Hirst, and other well-known gentlemen.

The following meetings have been arranged: November 15th, "Equivalent Temperature Tests on the Various Types of Electrical Machinery," by Dr. Kahn; December 13th, "Possibilities of Transmission by Underground Cables at 100,000/150,000 Volts," by Major A. M. Taylor; January 10th, "Technical Research with special reference to Electrical Engineering Development," by Mr. W. Wilson, M.Sc.; January 25th, joint meeting with local branches of the Institution of Civil and Mechanical Engineers; March 14th, "Metering," by Mr. W. Lawson.

Prof. W. Cramp, chairman of the Centre, delivered his presidential address before a large audience at Birmingham on October 26th. To begin with, the chairman paid a sterling tribute to the work of the late Prof. Gisbert Kapp. Turning to the Institution itself, Prof. Cramp said that in the early days the Council consisted of the best of the profession—able men, proved beyond all question. Now, the Council published a list showing what interest each member represented. That, to him, was utterly and fundamentally wrong. It led to a controversy on every important matter, the question invariably being, not what was right and best for the profession as a whole, but which interest could secure the most influence. The result was very apparent. Witness the change from 10 to 5 per cent. in the retention payment under the model conditions. Here was a victory for the manufacturing interest. Or, again, consider the narrow escape from hampering standardisation—almost from world-wide derision—in the proposal pressed forward, and nearly published, to adopt a form of fuse-holder suiting certain "interests," and excluding one at least of the best holders then made. With what joy would the prevailing interests have greeted their victorious representative on the committee, and with what grievous humility must the rest of them have received a decision so dishonourable. Yet, what other phenomenon could they expect if around the neck of every member of the Council they placed a large label denoting the interest he was there to represent, and, presumably, to serve. There was but one way to escape this Tammany disease—namely, to call upon all members in the Council Chamber to forget everything but that they were members of the Chartered Institution, called together for the advancement of engineering science. They must also beware of falling from the lofty objects of the Institution to the position of a trade defence organisation. In conclusion, the chairman advocated the encouragement and extension of the territorial Centres and a much more generous treatment of these financially; co-operation and, if possible, fusion with other engineering institutions ultimately to form one great English-speaking Institute of Engineers.

Liverpool Sub-Centre.—The following are the present arrangements for the current session: November 6th, Address by the Chairman, Mr. B. Welbourn; November 13th, "Wireless Broadcasting," by Mr. A. P. M. Fleming, C.B.E.; November 27th, "The Improvement of Power Factor," by the late Dr. Gisbert Kapp (to be read by Prof. Miles Walker, D.Sc.); December 11th, "Domestic Load Building," by Mr. W. A. Gillott; January 15th, 1923, "The Possibilities of Transmission by Underground Cables at 100,000/150,000 Volts," by Major A. M. Taylor; February 7th, "Electrical Propulsion of Ships," by Mr. R. S. Johnson (joint meeting with the Liverpool Engineering Society); February 19th, March 19th, and April 16th, Subjects to be announced later; April 30th, Annual general meeting and smoking concert.

Association of Mining Electrical Engineers.—At the opening meeting of the Midland branch on October 28th, at Nottingham, Mr. A. W. Williams, of Nottingham, was the principal speaker. He expressed the view that those who were concerned in work connected with electricity supply would need in future to pay greater attention to the proper allocation of blame for accidents alleged to have been caused by electricity, placing them in categories showing those which were preventable and those which were not. He thought the immediate past had clearly proved that electrical, mechanical and mining engineers must work hand in hand, so as to increase the output per man of the mines, because it was the low output which seemed to have crept into the industry, with its resultant low efficiency, that retarded progress.

Royal Society of Arts.—The arrangements for the present session, which opens on Wednesday, November 8th, at 8 p.m., with an address by the chairman (Lord Askwith) on "The Value of Strikes and Lockouts," include the following papers:—

November 17th.—"The Development of Water Power in India," by Mr. J. W. Meares.
November 22nd.—"The Economy of Smoke Abatement," by Baillie W. Smith.
November 27th, December 4th and 11.—"Brown Coal and Lignites," by Prof. W. A. Bone, F.R.S.
November 29th.—"The Hot-wire Microphone and its Applications," by Major W. S. Tucker.
April 30th, May 7th and 14th.—"Recent Improvements in Steam Turbines," by Mr. S. S. Cook.

The following papers are to be read after Christmas:—

Mr. C. R. Darling: "Electrical-resistance Furnaces and Their Uses."
Prof. W. A. Bone, F.R.S.: "Recent Developments in Surface Combustion."
Sir Richd. A. S. Redmayne: "The Base Metal Resources of the British Empire."
Mr. R. W. Church, F.R.S.: "Electrification of the Indian Coalfields."

Liverpool Engineering Society.—The first ordinary meeting of the session was held at the Royal Institution on November 1st, when the President (Prof. T. B. Abell) delivered his inaugural address.

Amongst the papers to be read during the session are the following:—

December 15th.—"Water and Water Power," by Mr. D. H. Thomson.
January 24th, 1923.—"Wave Transmission of Power," by Mr. W. Dinwoodie.
January 25th or February 1st.—Annual dinner.
February 7th.—"Electric Propulsion of Ships," by Mr. R. S. Johnson.
February 21st.—"High-ratio and High-speed Transmission Gears," by Mr. J. J. Clark.
March 7th.—"Hardening of Steel," by Prof. C. A. Bannister.
March 21st.—"Standardisation of Ships' Fittings," by Mr. C. Le Maistre.
April 4th.—"The Combustion of Fuel," by Prof. G. E. Scholes; and "Considerations in Design and Application of Surface Heaters," by Mr. B. Stephenson.
April 18th.—"Rating of Machinery," by Mr. E. W. Pierce.
April 25th.—Annual general meeting.

Wireless Society of London.—At the meeting of the Society, held on October 25th, the announcement was made that H.R.H. the Prince of Wales had consented to become the Patron of the Wireless Society of London and its affiliated societies.

Edinburgh Electrical Society.—At a meeting of the Society, held in the Philosophical Institute, on October 27th, Mr. J. G. Burchell, A.M.I.E.E., read a paper entitled "Electric Lighting Plants for Country Houses." The author outlined the variety of problems met with in fulfilling the requirements of modern detached installations, and described in detail typical plants. He considered the qualities of automatic, semi-automatic, and hand-operated engine and water-power sets. The paper was illustrated by slides and diagrams.

Institution of Civil Engineers.—On October 27th H.R.H. the Duke of Connaught unveiled the Institution's memorial to those of its members (346) who fell in the Great War. The memorial takes the form of a cast bronze figure of St. George flanked by six panels bearing the names of the dead. It looks down from the main staircase into the hall, and the architect of the building, Mr. James Miller, designed it.

The Duke of Connaught mentioned that of a membership of 9,000 a total of 3,000 joined the services. The dedication was pronounced by Bishop Ryle, Dean of Westminster, and a number of R.E. bandsmen played Chopin's *Marche Funèbre*, which was followed by the sounding of the "Last Post" and "Reveille."

Society of Chemical Industry.—A paper on "The De-Watering of Peat by Pressure" will be read by Prof. J. W. Hinchley in the Smoking Room of the Chemical Industry Club, London, S.W.1, on November 10th. Everyone interested, whether a member of the Club or of the Chemical Engineering Group, will be cordially welcome, as the paper deals with a method of reducing the water content of peat by mechanical means, and will be illustrated by quantitative data, diagrams, slides, and samples.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. H. C. Appleby, power plant specialist and consulting engineer to the Bradford Dyers' Association of Bradford, is shortly leaving this country to take up a post as power plant specialist and steam efficiency engineer with a large firm in South America. There were over 350 applications for the position.

Mr. Harry Richardson, who was engineer to Dundee Electricity Department for twenty years, has been presented with a gold wristlet watch and other gifts by the Town Council on the occasion of his removal to London. A high tribute was paid by the Lord Provost to Mr. Richardson's abilities. Mr. Richardson, in reply, said the department

could not be in better hands than those of his successor, Mr. Bishop, and its continued success was assured. The staff of the department presented Mr. Richardson with a leather-covered steel attaché case, &c. Replying, he said it was the team work among the men in the department that had assisted him in his advancement.

Mr. E. Harwood, a member of the staff of the Oxford Electric Co., recently received a presentation of a wallet containing Treasury notes upon his retirement after thirty years' service with the company. Sir Henry Mance, the chairman, made the presentation, and the chief engineer, Mr. F. R. Francis, presided.

Mr. Michael Flannery has been appointed manager of the Nenagh (Co. Tipperary) Gas & Electricity Supply Corporation.

Mr. H. H. Casse, who has been connected with the active management of the business of Chas. Bell, Ltd., of Bradford, for fourteen years, has been appointed a director of the company.

Mr. A. G. M. Dickson has been elected a director of the Chile Telephone Co.

New appointments to the Ministry which the King has approved include the following:—Postmaster-General, Mr. Neville Chamberlain; parliamentary secretary, Overseas Trade Department, Sir W. Joynson-Hicks; parliamentary secretary, Board of Trade, Lord Wolmer; and parliamentary secretary, Office of Works and Transport, Col. Wilfrid Ashley. An assistant Postmaster-General has not yet been appointed.

Mr. J. A. Robertson, consulting engineer, who was taken suddenly ill on October 6th at Edinburgh, while on a visit there with a deputation of the Salford Electricity Committee, and has since been laid up in a nursing home, is now progressing favourably, and hopes to be back at business in the course of two to three weeks.

Mr. A. S. Hampton, M.I.E.E., the chairman of the Scottish Centre of the Institution of Electrical Engineers, is electrical

Lafayette] [*Glasgow.*

Mr. A. S. Hampton,
Chairman of the Scottish Centre, I.E.E.

engineer and telegraph superintendent to the Caledonian Railway Co., Glasgow. He assumed that position in 1920, having previously held the appointment of assistant to his predecessor in the post for a period of about ten years.

Mr. E. C. H. Handcock, the present chairman of the Irish Centre of the Institution of Electrical Engineers, is an Irishman—a native of Clones, Co. Fermanagh. He received his technical training at the Finsbury Technical College, and upon leaving that institution entered, in 1900, the Meter Department of the British Thomson-Houston Co., London. After gaining experience in the various testing departments of the company, he left this country for the United States, where he entered the service of the Boston Elevated Railway Co., and, later, that of the General Electric Co. In 1905 he returned to the British Thomson-Houston Co. as chief of the turbine testing department, where he superintended the testing of all the company's large machines. He was then appointed as engineer to the Glasgow branch, and in 1912 was requested to open up an office for the company in Dublin, and to take charge of its Irish business. He remained in this position until quite recently, when he secured an interest in the W.M. Engineering Co., a concern which aims

The College Studios] [*Dublin.*

Mr. E. C. H. Handcock,
Chairman of the Irish Centre, I.E.E.

at freeing the Irish electrical industry from dependence upon outside sources. Mr. Handcock has been responsible for the electrification of a number of important industrial works in Ireland.

Wills.—Mr. A. E. Marlow, a director of the Northampton Electric Light & Power Co., Ltd., the Rushden & District Electric Supply Co., Ltd., and of the Wellingborough Electric Supply Co., Ltd., left £169,971.

Mr. W. H. Mathias, a director of the Treforest Electrical Consumers' Co., left £514,167.

NEW COMPANIES REGISTERED.

Bower Electric, Ltd. (185,066).—Private company. Registered October 17th. Capital, £30,000 in £1 shares. To carry on the business of electrical engineers, manufacturers, and vendors of, and dealers in electrical apparatus, machines, and accessories, &c. The subscribers (each with one share) are:—J. B. Bower, 17, Church Lane, Merton Park, Wimbledon, S.W.10, engineer; A. A. Henley, "Oak House," The Mount, Sydenham, S.E.26, incorporated accountant. The first directors are: J. B. Bower (managing and permanent director) and others appointed by the subscribers. Qualification of permanent directors, one share; of other directors, 100 ordinary shares. Registered office: 15, Kingston Road, Wimbledon, S.W.

Electrix, Ltd. (185,291).—Private company. Registered October 26th. Capital, £100 in £1 shares. To carry on the business of electricians, electrical and mechanical engineers and contractors, manufacturers of, and dealers in all apparatus and appliances for use in connection with the generation, distribution, supply, accumulation, and employment of electricity, &c. The first directors are:—S. B. Henderson, "Roseland," Wivelsfield Green, Haywards Heath, Sussex; P. Fer, Rexine House, 42, Newgate Street, E.C.1. Qualification: 20 shares. Solicitors: E. B. Gee & Co., 15, Copthall Avenue, E.C.2.

Richard Whaley, Ltd. (185,295).—Private company. Registered October 26th. Capital, £1,000 in £1 shares. To acquire the business carried on by R. Whaley at Leyway Engineering Works, New Islington, Manchester, and to carry on the business of manufacturers of, and dealers in wireless apparatus and instruments, &c. The first directors are:—R. Whaley, 14, Park Street, Clayton, Manchester; N. B. Sims, "The Lindens," 53, Linden Road, Levenshulme, Manchester (both permanent, subject to holding 300 shares each). Remuneration as fixed by the company. Secretary: N. B. Sims. Registered office: Leyway Radio Works, New Islington, Manchester.

Waltons (Liverpool), Ltd. (185,226).—Private company. Registered October 24th. Capital, £100 in 2s. shares. To acquire the business of W. H. Walton, carried on at 38, Beau Street, Liverpool, relating to the manufacture and sale of high resistances under P/P.20,506/22 and any improvements thereon, and to carry on the business of motor, electrical, mechanical, wireless, and general engineers, &c. The permanent directors are:—W. H. Walton, 61, Avondale Road, Southport; W. R. Atkinson, Sephton House, Liverpool Road, Great Crosby. Qualification: £10 shares. Secretary: A. D. Dean. Registered office: 28, Exchange Street East, Liverpool.

Runbaken Magneto Co. (Scotland), Ltd. (12,388).—Private company. Registered in Edinburgh, October 11th. Capital, £4,000 in £1 shares. To take over as a going concern the business of electrical ignition specialists and repairers carried on by F. Murray & Co., at 136, West Nile Street, Glasgow. The first directors are:—J. H. Runbaken, "Maryvale," Hill Top, Wilmslow, Cheshire, company director; P. Forrester, "Bullechmyle," Blundellsands, Liverpool, company director; S. H. Flynn, 7, Beatty Road, Southport; F. W. Murray, 34, Bath Street, Glasgow, motor accessory factor. Qualification: 100 shares. Registered office: 134, West Nile Street, Glasgow.

Markes, Ward & Co., Ltd. (185,204).—Private company. Registered October 23rd. Capital, £2,000 in £1 shares. To carry on the business of merchants, manufacturers, agents or factors, manufacturers of, and dealers in glass, porcelains, metals, carbons, wire cables, conductors, motor-car accessories and materials, machinery, lamps, electrical goods and apparatus, &c. The first directors are:—P. D. Morris (chairman), 6, Canonbury Grove, Islington, N.1; A. S. Markes, "Nokomis," Beach Road, Shoreham; J. W. Ward, 18, Sherriff Road, West Hampstead, N.W.6; E. E. Morris, Church Road, Ashtead, Surrey. Qualification: £100. Remuneration (except managing director or joint managing director) as fixed by the company. Secretary: H. B. Clark. Registered office: 26/30, High Street, Islington, N.1.

Thomas Wood & Co., Ltd. (185,208).—Private company. Registered October 23rd. Capital, £200 in £1 shares. To carry on the business of electrical and general engineers, &c. The first directors are:—T. Wood, 18, High Street, Cheadle, Cheshire; Ada M. Wood, 18, High Street, Cheadle, Cheshire. Remuneration as fixed by the company. Secretary: T. Wood. Registered office: 18, High Street, Cheadle, Cheshire.

Pryco, Ltd. (185,187).—Private company. Registered October 21st. Capital, £2,000 in £1 shares. To acquire the business carried on by E. A. Pye and E. B. Taylor as "Pryce & Co." and "Wright, Pryce and Co.," at 14a, Chouldham Street, Marylebone, and elsewhere in London, as electrical engineers and dealers in electric lamps, signs, and all kinds of electrical appliances, &c. The subscribers (each with one share) are:—C. Jaeger, 31, Parliament Hill Mansions, N.W.5, general merchant; J. W. Basham, 76, Holland Road, Harlesden, N.W.10, accountant; O. Bird, 4, Great St. Thomas Apostle, E.C.4, solicitor. The first directors are not named. Secretary: J. W. Basham. Registered office: 4, Great St. Thomas Apostle, E.C.4.

Crieff Electric Supply Co., Ltd. (12,402).—Registered in Edinburgh, October 19th. Capital, £12,000 in £1 shares. To generate and supply electric current for light, power, and any other purpose in or near Crieff. The subscribers (each with one share) are:—W. H. Mungall, "Croftwert," Crieff, retired engineer; A. B. Graham, "Auld House," Crieff, retired merchant; A. M. Wilson, "Roundelwood," Crieff, merchant; W. Watts, "Lincluden," Crieff, chemist; J. Alexander, Comrie Street, Crieff, baker; C. E. Colville, Crieff, solicitor; J. Denwoodie, Union Bank House, Crieff, bank agent. Minimum cash subscriptions: 8,000 shares. The first directors are:—W. H. Mungall, W. Watts, T. Brook, "Avondale," Crieff, retired shipowner; A. N. Rye, 6, Eaton House, Belsize Park Gardens, N.W., electrical engineer; E. J. Williams, 7, Queen Gate, Inverness, electrical engineer. Qualification: 50 shares. Secretary: Charles E. Colville. Registered office: 14, Comrie Street, Crieff.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Marston Billington, Ltd.—Satisfaction in full on June 16th, 1922, of debentures dated May 27th, 1920, securing £20,000.

Egham and Staines Electricity Co., Ltd.—Satisfaction in full on October 5th, 1922, of mortgage debentures, dated October 21st and November 25th, 1912, April 13th and June 26th, 1913, and August 2nd, 1918, securing £17,000.

Dunn & Co. (Cheltenham), Ltd.—First and second mortgage debentures, dated October 13th, 1922, to secure £500 and £200 respectively, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: W. E. Thomson, "Chalfont," The Park, Cheltenham; and C. Lloyd, "Karr's Cottage," Leckhampton Road, Cheltenham.

Cross & Cross, Ltd.—Satisfaction in full on October 11th, 1922, of debentures dated December 11th, 1909, securing £600.

Electric Hose & Rubber Co., Ltd.—Satisfaction in full on August 16th, 1922, of deeds of charge dated November 3rd, 1914, and July 5th, 1921, securing the cash owing by the company to the London County, Westminster & Parr's Bank.

Snowdon Mountain Tramroad & Hotel Co., Ltd.—Satisfaction in full on October 5th, 1922, of debentures dated March 13th, 1897, securing £2,000.

Excelsior Magneto & Ignition Co., Ltd.—Debenture dated October 5th, 1922, to secure £300, charged on the company's property, present and future, including uncalled capital. Holder: A. Reid, 181, North Road, Clayton, Manchester.

Lighting, Heating & Power Installations Co., Ltd.—Debenture dated October 12th, 1922, to secure £100, ranking *pari passu* with previous series, charged on the company's property, present and future, including uncalled capital. Holder: G. A. T. Jesson, "Endsley," Swinton, Manchester.

Minehead Electric Supply Co., Ltd.—Second mortgage debenture dated October 12th, 1922, to secure £4,500, charged on the company's undertaking and property, including uncalled capital. Holder: The Treasury Solicitor.

CITY NOTES.

Drake and Gorham, Ltd.

At the annual meeting, held on October 26th, the chairman, Mr. B. M. Drake, said that, in view of the abnormal conditions which industrial enterprises of all kinds had experienced during the past year, when many electrical companies had had to face heavy losses, it was at any rate satisfactory that they were in a position to recommend a small dividend. The gross profit of £41,390 compared with £63,157 in the previous year, but the expenses had been reduced by £12,338. The item of investments in the balance sheet, £57,047, consisted of securities quoted on the London Stock Exchange, over £50,000 being in British Government Funds. Shares in associated companies, £69,502, referred almost entirely to their wholesale sub-company, which incurred a considerable loss last year, thereby curtailing the dividend which they would otherwise have been in a position to pay. It was a poor consolation, but this had been the common experience of other factors working on similar lines. With an improvement in trade, a return to the profits earned in the past might be anticipated, and in the meantime the directors were reducing the outgoings as far as possible. During the year work had been carried out for the War Office at Seaford Camp and Chelsea Barracks, for the Ministry of Pensions, the Earl of Derby and many other well-known people, companies, banks, &c.

The company has in hand the lighting of two bleach works for Messrs. Deakins, Ltd., the re-modelling of a large lighting equipment at the Birkenhead Depôt of the Anglo-American Oil Co.; a complete generating plant and kinema equipment and considerable private installation work for mansions, mills and factories. In the utilisation of water-power they had patented an automatically regulated generator for use with water turbines, which would enable full use to be made of existing water-power without the expense of a governor which, in some cases, cost more than the turbine it controlled. Any current not required for power or lighting was rendered available for heating or other purposes, without the use of an accumulator. The works had executed numerous orders for switchboards and electrical apparatus, and they had commenced to manufacture broadcasting receiving sets; they were developing this new branch of the business as quickly as circumstances permitted. They were also turning their attention to electric furnaces for all purposes, and had made a provisional agreement to represent an important Amercian company which had designed and erected many of the largest and most successful electric furnaces in the States. Although the attitude of labour in the electrical trade had certainly improved, it would take some time to counteract the effects of the disastrous policy adopted in the past, and the position was not helped by the continuance of the payment of doles, which in many cases acted as a premium on laziness. He was pleased to hear from their engineers that the output of their electricians showed a marked improvement. Work made work, and the lower the cost at which installations could be equipped the more men they would be able to employ. No doubt some had been postponing electrical work until prices were stabilised, but in view of the large reductions which had taken place, and the fact that contractors were working at little or no profit in order to find work for their unemployed, he was of opinion that there would be a rise in prices as trade improved. With regard to the future they could only hope that the slight improvement shown in trade might extend, but he was afraid this could not take place to any marked degree until some means was found of reducing the present heavy taxation, which was crushing the life out of industry and restricting outlay on the part of individuals. The directors had carefully examined, from time to time, projects which had been brought to their notice with a view to utilising the additional capital raised by the issue of £50,000 in 10 per cent. seven-year notes, but as it was considered undesirable to lock up this capital in enterprises which might not bear fruit for some years, and the rate of interest payable was high, it had been decided to pay off about half these notes, so as to leave £25,000 outstanding, after taking into account the amount already redeemed.

French Companies.

The Société de Construction Electrique, of Lyons, has just declared a dividend at the rate of 13.50 fr. per share out of net profits of 734,000 fr. in 1921-22.

The accounts of the *Société des Accumulateurs Dinin* are reported to show a credit balance of only 34,000 fr. for 1921-1922, as compared with 301,000 fr. in the previous year.

The report of the *Société Bréguet* states that the net profits in 1921-22 amounted to 1,866,000 fr., or 125,000 fr. more than in the previous year, and the dividend is at the rate of 50 fr. gross per share. The directors state that the results were satisfactory. That was due to the fact that they had had no confidence in the duration of the period of apparent prosperity which followed the armistice, and which was characterised by an exaggeration of prices and a scarcity of materials. By refusing to increase the company's productive capacity in proportion to the orders booked in that period it had been possible to keep the works fully occupied with the execution of orders dated from 1919 and 1920, and these had just been completed. On the other hand, the directors had endeavoured to devote greater attention to the carrying out of mechanical and electrical applications, seeing that there were always new problems to solve. The new workshops at Douai would be able to be brought into operation early in 1923, and the construction of electrical apparatus would be centralised there. At the same time the former would be able to assist the Paris works in the matter of ship turbines.

The report of the year's working of the *Société Bretonne d'Electricité* shows receipts 1,892,948 fr. and expenditure 1,436,662 fr., leaving a balance of 456,285 fr., contrasted with 234,818 fr. in 1920. The net profit, after deduction of sundry charges, totalled 82,571 fr., which was carried forward. The company has completed the enlargement of its central station, whose power now totals 5,500 kW. Progress has been made with the electrification of the city of Lorient and the construction of networks in various communes.

The accounts of the *Gazet Electricité de Valence* for the year 1921 showed a credit balance of 148,609 fr., including 21,973 fr. brought forward. The dividend was fixed at 6.5 per cent. per share, being 13.12 fr. to priority shares, 16.25 fr. to ordinary shares, and 15.50 fr. to bearer shares. Owing to the lower price of coal, a saving of 578,967 fr. was made; but,

on the other hand, a loss of 738,117 fr. had resulted from the lower price obtained for the gas department's output of coke. A more favourable agreement had been signed with the municipal authorities with regard to the tariff for gas and electricity.

Montevideo Telephone Co., Ltd. For the year ended July 31st the Montevideo Telephone Co. secured a net profit of £28,996 (against £27,555). After transferring £10,000 (the same) to reserve, the directors propose a final dividend of 5 per cent., free of tax, making 8 per cent. for the year (the same), while a balance of £13,782 is carried forward (against £12,157 brought in). The loss in exchange amounted to £7,331 (against £1,007). A resolution was submitted after the general meeting of the company on November 1st sanctioning the *ad referendum* agreement for sale to the Administration of Posts, Telegraphs, and Telephones of Montevideo. The agreement provides for the sale to the Administration for the sum of $700,000 (about £120,000) of the company's rights and privileges, plant, subscriptions, materials, and stores in Uruguay, and of the right of the Administration, for not more than four years, to occupy the company's properties in Montevideo. All money in cash and deposited at bank, and all freehold properties and securities held by the company, will not be included in the sale to the Government.—*The Times.*

Italian Companies. The report submitted to the shareholders of the *Società Padana di Elettricità* showed a net balance of 179,161 lire, from which a dividend of 10 per cent. on its capital of 1,500,000 lire was sanctioned. The company's operations are limited solely to the distribution of electricity, and it has lately ceded to the Società Elettrica Bresciano its installations to the north of the Po River, while at the same time improving its own network.

The *Società Anonima Trazione Elettrica Lombarda*, of Milan, has decided to increase its capital from 7,000,000 to 8,000,000 lire by the issue of 2,000 500-lire shares.

The *Società Illuminazione Elettrica*, of Spinazzola, is making an issue of new shares of 1,000 lire each to a total of 60,000.

Amalgamated Wireless (Australasia), Ltd. At the annual meeting in Sydney on September 7th, the chairman, Mr. C. P. Bartholomew, announced that the Prime Minister, Mr. W. M. Hughes had accepted a seat on the board. The whole of the coastal wireless service was taken over on May 8th, and the New Guinea service on July 1st, and, although only a short time had elapsed, many improvements had been effected. The agreement with the Commonwealth Government ensured that the organisation would be developed upon commercial lines during peace, and in war would be handed over to the Government as a complete working unit.

Herbert Morris, Ltd.—The profit for the year ended July 31st last, after making allowance for taxes, was £57,242 (against £70,878) plus £5,522 dividends from investments, £4 transfer fees, &c., and £20,294 brought in, less directors' fees, preference dividends, ordinary dividend for first half-year, and depreciation, leaving £45,261. A further dividend, making 10 per cent., free of tax, is recommended on the ordinary shares; £10,000 is placed to reserve (against £25,000); and £16,823 is carried forward.

Parramatta Electric Supply Co., Ltd.—The accounts for the year ended June 30th last disclosed a net profit of £3,168, which, together with £1,361 brought forward, gave a total of £4,529. After providing for taxation a sum of £3,202 remained for distribution. A dividend of 8 per cent. was paid on the ordinary capital (£1,940) in shares, and a similar dividend in cash on the cumulative preference shares. £1,000 was placed to income tax reserve and the balance carried forward.

An Austrian Company.—*The Austrian Berliner Co.*—The accounts of the Austrian Telephone Works Co. (late J. Berliner) show net profits of 149.5 millions of crowns for 1921-22, and the dividend is at the rate of 200 crowns (100 per cent.). It is intended to increase the share capital from 50,000,000 to 250,000,000 crowns.

Companies to be Struck off the Register.—The following companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary:—

Boardman Electrical Patents Co., Ltd.
Immisch Electric Launch Co., Ltd.
London Sherardising Co., Ltd.

Vickers, Ltd.—A petition has been presented to the High Court for the confirmation of the alteration of the provision of the memorandum with respect to the company's objects proposed to be effected, and will be heard by Mr. Justice Laurence, in London, on November 14th.

Calcutta Electric Supply Corporation, Ltd.—Interim dividend on the ordinary shares issued prior to July, 1922, at the rate of 4 per cent. actual for the half-year ended June 30th, 1922.

City of Buenos Aires Tramways Co. (1904), Ltd.—Dividend of 1s. 3d. per share (being at the rate of 5 per cent. per annum), less tax, for three months ended September 30th.

Electrolytic Zinc Co., of Australasia.—At a recent meeting of the company the chairman announced the probability of an early dividend on the ordinary shares, which are chiefly held by the Zinc Corporation, the Amalgamated Zinc, the North Broken Hill and South Broken Hill Companies.—*Financial Times.*

Underfeed Stoker Co., Ltd.—Interim dividend at the rate of 7½ per cent. (free of tax).

STOCKS AND SHARES.

Tuesday Evening.

The prevailing tendency of the House continues to be coloured a good deal by the forthcoming General Election, which has the effect of checking business, and by the weakness of the French franc, which arouses anxiety, not to say alarm, over a wide circle of investors. Prices have considerable difficulty in making any headway; the sharp rise in the price of tin is an example of the fact that even favourable influences fail to make much impression against the dulness in business provoked by the two causes just mentioned.

Home Railway stocks are exciting a little more attention, though in their case it is argued that, with the bare possibility of a Labour majority either in this Parliament or the next, it is skating on somewhat thin ice to buy such securities, though this does not apply, of course, to the prior-charge stocks. Investment money continues to flow steadily into the 4½ per cent. debentures of the three Tube issues recently made, the prices of which remain at about ¾ discount for the partly-paid, and 92¾ for the fully-paid; 93 being the price of issue. Districts have gone back, and there is a lull in the talk of the Metropolitan Railway being taken over by the Great Western, though, when Great Westerns spurted a few days ago, Metropolitans enjoyed a mild improvement in sympathy. The shares of the Underground Electric Railways are easier. No particular importance is attached to the talk of an immediate announcement regarding a reorganisation of the company's capital.

Power Securities, Ltd., has been making an appeal for capital this week on a somewhat unusual prospectus, which offered half-a-million 7 per cent. participating preference shares at 20s. and 100,000 ordinary shares at 22s. per £1 share. The unusual part of the prospectus lies in the omission of any estimate of profits, which according to the document, will be derived from interest on advances, dividends on investments, underwriting and other commissions. The company is under the auspices of the Armstrong, Babcock & Wilcox, and the British Thomson-Houston Companies, while it has amalgamated with Balfour, Beatty & Co. Speculation is agog to see how the issues will go, though with such names at the back of the company, it may be regarded as tolerably certain that after the allotment, the shares will settle down into permanent hands, and probably command a premium.

The dramatic rise in cable stocks and shares halted at about the levels reached last week. Globe ordinary rose ½; Westerns and Eastern Extensions are ½ down. People are beginning to ask whether the latest invention of Mr. Marconi, whereby he claims to be able to obtain complete secrecy in messages sent from points a hundred miles distant from each other, is likely to reflect unfavourably upon the profits of the submarine cable companies. These latter have hitherto been regarded as placed in a particularly strong position owing to the secrecy which their messages command, as compared with wireless waves, capable of being tapped by many and sundry. If the Marconi system can compete in secrecy with the cables, it is asked whether the latter can hope to retain the important hold which they possess over the traffic. The answer appears to be, that the experience of the past twenty years has amply demonstrated that there is plenty of room for both systems. That holders of cable stocks are by no means disturbed by the prospect of wireless messages being as secret as those which go underground is manifest by the fact that nobody is attempting to sell cable shares.

The prospectus of the Marconi 6½ per cent. debentures at 99 is expected to be circulated at the end of this week. The debenture will be short-dated and convertible into shares at £3 per share. Underwriters receive 2 per cent. commission. Shareholders in the Marconi company will have the right to apply for half the total amount, and should take care that they exercise this, as there is every probability of an early premium being established on the bonds. Marconi shares are 1/16 down at 2 5/16 on sales by proprietors who intend to take up their proportion of the new issue.

London Electrics have had a sudden rise of 10s. to 3½, on demand from those who expect the company to derive substantial profit from railway electrification schemes. An inquiry came this week, from Glasgow of all places, for Kent Electric ordinary. In these shares there is no market, they can be sold at a modest price, but none are on offer. No

doubt the demand in this case arises from some idea that the Kent company may benefit from the intention to electrify part of the South-Eastern & Chatham Railway. Metropolitans rose 5s. to 6½. The list otherwise shows no change.

Metropolitan-Vickers ordinary are better at 25s. 3d. Iron, steel and armament shares present a firmer appearance all round, on the more cheerful trade reports that come from the provinces. Babcocks hold their good rise at 65s. Armstrongs and Vickers have both advanced. Electricity and cable manufacturing shares are not much altered. General Electric ordinary are lower at 18s. Electric Constructions have gone up 9d. to 25s. 6d.

Brazilian Tractions at 46 are easier, and the preferred have receded to 88. The public are becoming uneasy at the continual shrinkage in the value of the Brazilian milreis, which dropped to a shade below 6d. before it rallied to 6 5/32d. Until Europe's purchasing powers are recuperated, Brazil is bound to feel the effect of the enforced restriction laid upon the customers for her exports; coffee and rubber are, of course, two of the most important. Anglo-Argentine Tramways second preference weakened a trifle: the 5 per cent. debenture stock is 2 points higher. British Columbia preferred has lost two and the only movement amongst Mexican Utilities is a gain of one in the Light & Power common shares. The rubber market exhibits a good deal of animation, although business has fallen away as compared with what it was a fortnight ago. The rush of trade in rubber shares proved sufficient to render it necessary for a good many Stock Exchange offices to work during this week's holiday on November 1st, All Saints' Day.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1920.	Dividend 1921.	Price Oct. 31, 1922.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	8½	—	£7 1 2
Charing Cross Ordinary	8	9	7⅞	—	5 18 0
do. do. do. 4½ Pref.	4½	4½	4	—	5 12 6
Chelsea	6	6	6½	—	4 12 4
City of London	14	14	21/2	—	6 15 7
do. do. 6 per cent. Pref.	6	6	23/-	—	5 4 4
County of London	8	8	1⅞	—	5 11 4
do. do. 6 per cent. Pref.	6	6	1⅛	—	5 4 4
Kensington Ordinary	9	10	7½	—	6 13 4
London Electric	2½	4	3⅝	+ ⅛	3 14 9
do. do. 6 per cent. Pref.	6	6	5	—	5 17 1
Metropolitan	7	7	6½	+ ½	5 7 8
do. 4½ per cent. Pref.	4½	4½	4	—	5 12 6
St. James' and Pall Mall	12	12	9⅛	—	6 11 6
South London	7	7	4	—	7 0 0
South Metropolitan Pref.	7	7	1.⅝	—	5 18 0
Westminster Ordinary	10	10	7½	—	6 9 0

Telegraphs and Telephones.

Anglo-Am. Tel. Pref	6	6	102	+1	5 17 6
do. Def.	1½	84/6	23½	— ½	7 6 6
Chile Telephone	6	6	6⅛	—	4 18 0
Cuba Sub. Ord.	7	7	8⅛xd	—	8 12 4
Eastern Extension	10	10	19⅜	—	5 3 3
Eastern Tel. Ord.	10	10	193½	+ ½	5 3 0
Globe Tel. and T. Ord.	10	10	19½	+ ½	5 2 7
do. do. Pref.	6	6	11½	—	5 4 4
Great Northern Tel.	24	22	28	—	7 17 2
Indo-European	10	10	35½	—	7 1 0
Marconi	25	15	2 1/16	— 1/16	6 9 6
Oriental Telephone Ord.	12	12	2⅝	—	*6 4 0
United R. Plate Tel.	8	8	7⅜	—	*5 16 0
West India and Panama	Nil	Nil	8/-	—	Nil
Western Telegraph	10	10	19½	+ ⅛	*5 2 7

Home Rails.

Central London Ord. Assented	4	4	87	—	5 19 5
Metropolitan	1½	2½	54½	— ½	4 2 7
do District	Nil	1	40½	—1	2 9 5
Underground Electric Ordinary	Nil	Nil	8	— ½	Nil
do. do. "A"	Nil	Nil	7/-	—6d.	Nil
do. do. Income	2	4	86½	—1	*4 12 5

Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5½	12½	85	—	7 11 9
do. do. 2nd Pref.	Nil	6½	8⅞	— ⅛	7 3 6
do. do. 5 per cent. Deb.	5	5	82½	+2	6 2 2
Brazil Tractions	Nil	Nil	46	—1	8 10 2
British Columbia Elec. Ry. Pcc.	5	5	70½	—	6 9 9
do. do. Preferred	5	93/-	88	—2	*7 2 6
do. do. Deferred	8	194/-	71½	—	*8 12 6
do. do. Deb.	4½	4½	73	—	6 16 5
Mexico Trams. 5 per cent. Bonds	Nil	Nil	72½	—	7 1 10
do. do. 6 per cent. Bonds	Nil	Nil	43½	—	Nil
Mexican Light Common	Nil	Nil	20½	+1	Nil
do. Pref.	Nil	Nil	40½	—	Nil
do. 1st Bonds	Nil	5	80½	—	7 14 8

Manufacturing Companies

Babcock & Wilcox	15	18	2½	—	4 18 6
British Aluminium Ord.	10	5	17 9	—	5 12 8
British Insulated Ord.	15	15	44/6	—	6 14 10
Callenders	15	15	2½	—	6 13 4
" 6½ Pref.	6½	6½	1½	—	5 15 7
Crompton Ord.	10	5	15/-	—	6 13
Edison-Swan	10	Nil	3/-	—	Nil
do. do. 5 per cent. Deb.	5	5	64	—	7 16 4
Electric Construction	10	10	2½	+9d.	7 17 0
English Electric	8	5	15/0	—	6 7 0
do. do. Pref.	6	6	18/8	—	6 8
Gen. Elec. Pref.	6½	6½	21/8	—	6 2 4
do. Ord.	10	5	18/-	—6d.	5 8 1
Henley	15	15	2½	—	6 9 10
do. 4½ Pref.	4½	4½	6⅞	—	6 2 10
India-Rubber	10	—	14/6	—	—
Met.-Vickers Pref.	8	8	2⅝	—	6 14 9
Siemens Ord.	15	15	25/9	—	*7 15 4
Telegraph Con.	20	20	22½	—	*4 13 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

Wednesday, November 1st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	7½d.	...
a Ammoniac, Sal	per ton	£63	...
a Ammonia, Muriate (large crystal)	"	£48	...
a Bisulphide of Carbon	"	...	...
a Borax	"	£30	...
a Copper Sulphate	"	£26 10s.	...
a Potash, Chlorate	per lb.	5d. to 5½d.	...
a " Perchlorate	"	7½d.	...
a Shellac	per cwt.	£15 15s.	£1 inc.
a Sulphur, Sublimed Flowers	"	£9	10s. dec.
a " Lump	"	£8 10s.	10s. inc.
a Soda, Chlorate	per lb.	9½d.	...
a " Crystals	per ton	£6	...
a Sodium Bichromate, casks	per lb.	5d.	...
METALS, &c.			
b Aluminium, Ingots	per ton	£100	...
b " Wire	per lb.	1/9 to 2/6	...
b " Sheet	"	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—			
Grade I	per ton net	£171	£12 inc.
Grade II	" "	£122	£8 inc.
Grade III	" "	£99	£4 inc.
c Brass (rolled metal 2' to 12' basis)	per lb.	9½d.	...
c " Tubes (solid drawn)	"	11⅜d. to 1/-	...
c " Wire, basis	"	9½d.	...
c Copper Tubes (solid drawn)	"	1/1½	...
c " Bars (best selected)	per ton	£96	...
c " Sheet	"	£96	...
c " Rod	"	£96	...
d " (Electrolytic) Bars	"	£70 15s.	20s. dec.
d " " Sheets	"	£145 10s.	...
d " " Wire Rods	"	£80 15s.	20s. dec.
d " " H.C. Wire	per lb.	10½d.	½d. dec.
f Ebonite Rod	"	3/6	...
f " Sheet	"	3/-	...
n German Silver Wire	"	2/6	...
h Gutta-percha, fine	"	12/6	...
h India-rubber, Para fine	"	1/1½	1½ inc.
l Iron Pig (Cleveland Warrants)	per ton	92s. 6d. to 93s.	...
l " Wire, galv. No. 8, P.O. qual.	"	£24	...
g Lead, English Pig	"	£27 10s.	20/- inc.
g Mercury	per bot.	£12 to £12 5s.	5/- to 10/- inc.
e Mica (in original cases) small	per lb.	3d. to 3/-	...
e " " medium	"	4/- to 8/-	...
e " " large	"	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings	"	1/1	...
p " drawn bars and rods	"	1/3	...
p " rolled strip & sheet	"	1/2½	...
p " wire	"	1/3½	...
o Platinum	per oz.	£23	£3 dec.
d Silicium Bronze Wire	per lb.	10½d.	½d. dec.
r Steel, Magnet, in bars	"	10d.	2d. dec.
n Tin, Block (English)	per ton	£170 10s.	...
n " Wire, Nos. 1 to 16	per lb.	2/2	2d. inc.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r. W. F. Dennis & Co.

Freemasonry.—On Friday last, at Mark Masons' Hall, W.-Bro. E. E. Sharp, the retiring Master, installed Bro. P. C. Ebner, A.M.I.E.E. (an engineer on the staff of the Borough of Shoreditch electricity undertaking), in the chair of the Kelvin Lodge. Afterwards a banner presented to the Lodge by one of the founders was unveiled by W.-Bro. Percy Still, M.I.E.E., P.G.S.D., who gave a brief but eloquent address. Amongst the visitors present were Mr. C. F. Quicke, P.G. Supt. Wks., Mr. J. W. Meares, C.I.E., electrical adviser to the Government of India, and Messrs. A. J. Cridge, R. E. Neale, H. P. Guy, A. H. Allen, H. E. Burrows (W.M. Electric Lodge), J. S. Plumtree, and W. Wyld.

Steel Battery Cases.—An interesting announcement was recently made by the National Carbon Co., Inc., U.S.A., manufacturers of dry batteries and carbon products. The most popular type Columbia "Hot Shot" battery, No. 1461—a four cell, 6-volt battery—which has been sold in a fibre container is now being put on the market in a new steel container. This new battery is a very great improvement on the old type which it replaces. Important advantages claimed by the manufacturers for the new steel case include the following:—Superdurable, waterproof, thoroughly insulated, to prevent internal short circuits, unbreakable, portable—a new woven fabric handle for comfort, strength and convenience. The new container is lithographed in colours, thus presenting an attractive appearance. At the same time the nature of the materials used in lithographing the container also serves as an electrical insulation for the outer surface. The price is to be exactly the same as that of the old fibre-container battery. Other standard types of Columbia "Hot Shot" batteries are to be put into steel containers.—*T. & T. Age.*

THE FLEETWOOD AUTOMATIC TELEPHONE EXCHANGE.

THE FIRST PUBLIC RELAY INSTALLATION.

Inventive effort applied to various basic ideas of automatic switching has resulted in the development of several automatic telephone systems, most of which are founded on the principle of successive group selection through the medium of electro-mechanical switching devices controlled by impulses emanating from subscribers' instruments.

In one system, however, all electro-mechanical switching devices, in the accepted sense of the term, have been excluded, and even successive group selection is only utilised to a limited extent. The "Relay" system (which has been described in our pages) is built up entirely with relays; all operations in the exchange, including circuit hunting, connecting, and even ringing, are executed by means of relays, without the intervention of any mechanical gear. The Relay Automatic Telephone Co., Ltd., has evidently been actuated by the resolve to utilise only the simplest apparatus available to attain the object in view, and there is probably no telephone apparatus whose performance and durability under varied climatic conditions are better

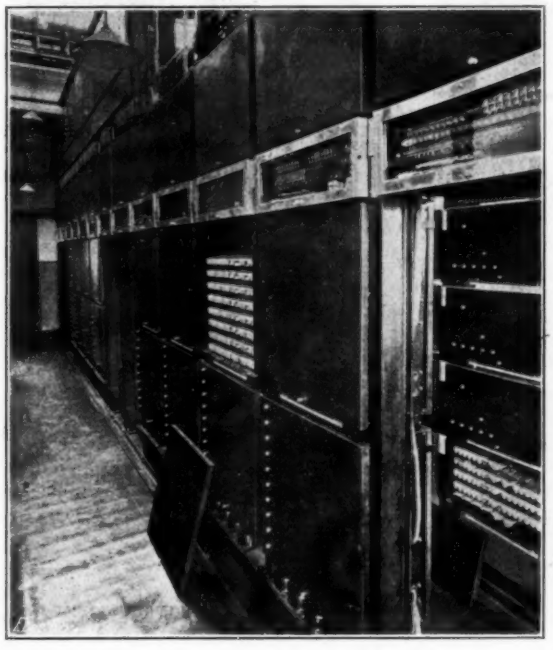


Fig. 1.—Common Apparatus Rack.

known than those of the relay. The early exchanges have proved how extraordinarily reliable such apparatus can be made.

The development of the system in 1914 constituted, in our opinion, a noteworthy advance in automatic telephony, and it is unnecessary to reaffirm our conviction as to its inherent excellence. It will suffice to record that a large number of exchanges have been installed for private service, some of which (*e.g.*, the *Liverpool Courier*, North-Eastern Marine Engineering Co., Ltd., and India Stores Depôt) have connection to the public service, while other similar plant (ranging in size from 20 to 1,200 lines), which will be rented by the Post Office to subscribers, is in hand. The Swedish Co. installed a trial 1,000-line semi-automatic public exchange in Stockholm in 1917 for the Swedish Government, whose official records show that during two years only one exchange fault was reported on an average for every 92,000 calls and only one contact fault for every 195,000 calls, a result which speaks for itself, while the several exchanges supplied by the English Co. to the India Office are fully confirming the confident opinion that the "Relay" system is ideal for tropical use.

The exchange at Fleetwood, which we had the pleasure of inspecting last week, is the first public one to be installed for the Post Office in this country, and was brought into service in July of this year. For several days after the exchange was brought into use, no faults whatever were reported (a most remarkable performance), and during the 3½ months the exchange has been working the number of faults generally has been extremely low.

The exchange was designed to meet the specifications of the Engineer-in-Chief of the British Post Office. During its manufacture each new requirement for automatic exchanges that was standardised by the Post Office and included in its latest automatic exchange specifications was added to the plant, so that when the exchange was brought into use it embodied every improvement to date.

The opening of the Fleetwood exchange marks an era in the development of automatic telephony in this country, for it is the first of its size that is completely automatic (*i.e.*, without local operators for junction and trunk calls and inquiries).

Subscribers are provided with Post Office standard telephones with dial, which are each connected to the exchange by two wires without earth connection. A

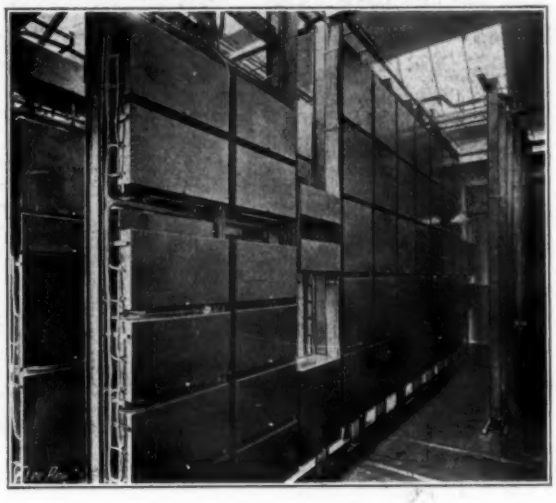


Fig. 2.—Back of Recorder Rack.

Fleetwood subscriber making a local call removes the receiver from the hook and immediately the dialling tone is heard; the dial is then operated the requisite number of times (once for each digit), and if the called number be disengaged, connection is made and the distant bell is ringing within about five seconds. The call is automatically metered against the calling subscriber at the end of the conversation when he replaces his receiver on the hook. If the called subscriber does not answer, or certain special numbers are called, the call is not metered. A unique alarm is provided so that if a subscriber's meter does not operate correctly, a warning signal is given; by this means the meters are kept under continuous observation.

It is the usual practice for a manual board to be located near the automatic board in order that connection can be made by means of junction and trunk lines with the public system. In the case of Fleetwood, however, there is no manual board locally, and junctions (two-wire) run direct from the automatic board to the Blackpool Central manual board (nine miles away).

When a Fleetwood subscriber makes a call for trunks or any exchange other than Fleetwood, he dials 0, and in so doing gets automatically connected to an idle junction to Blackpool, where his call is handled manually; the Fleetwood subscriber, however, gives a clearing signal to the Blackpool operator immediately he hangs up his receiver. Similarly for "inquiries" the subscriber dials 9, and is also automatically connected to Blackpool.

In a like manner calls in the reverse direction are completed by the operators on the manual board at Blackpool Central dialling over two-wire junctions to Fleetwood. In this case also the Fleetwood subscriber lights a clearing lamp in front of the Blackpool operator when he replaces his receiver on the hook. If the Fleetwood subscriber is engaged when dialled by Blackpool, the operator gets the busy-back tone and the clearing lamp flashes intermittently. If it is a trunk call, the operator can, over a special junction obtain connection with the engaged subscriber and offer the trunk call. The operators at Cleveleys (another exchange in the same area) also obtain Fleetwood calls direct by dialling the required number.

It will be appreciated that the entire elimination of the operator at the automatic exchange opens up avenues for effecting economies in the direction of operators' wages, accommodation, and supervision.

The whole of the apparatus is accommodated on one floor. The exchange is planned for an ultimate of 920 lines, about half of which are in use at present, with 40 junctions outgoing to and 40 junctions incoming from Blackpool and other exchanges, and occupies a total floor space of 875 sq. ft., 330 sq. ft. of which are occupied by the power plant, test desk, and batteries.

General views of the Fleetwood equipment are reproduced in the accompanying illustrations: Fig. 1 shows the common apparatus rack, *i.e.*, in junction feeds, ringing groups, AB feeds, trunk connecting groups, fuse and alarm groups; the recorders on the second rack, the back of which is shown in fig. 2, are seen through the first bay (on the right). The third illustration shows the motor generator, main distributing frame, trunk offering bay, intermediate distributing frame, and the meter rack, while fig. 4 shows the battery-charging board and ringing machines.

Although the basis of the design of the relay was a well-known telephone type that had stood the test of practice, the company modified the design so that it rarely requires adjusting after it leaves the factory, and continues functioning with a minimum of attention; thus maintenance costs are reduced to the lowest possible figure. The small brass stud usually fitted in a relay armature to prevent it sticking by residual magnetism to the core is replaced by a strip of metal which has a much larger area and does not hammer out and so alter the timing of the relay—a vital point in automatic working. In order to make the relay suitable for tropical conditions, fibre and ebonite are excluded and only micanite and filled insulating materials, such as empire cloth, are used. The contact pressure is not less than 1¼ oz. per contact, and is ensured by the employment of a special bronze for the springs, which does not lose its tension with prolonged use. That the results aimed at are being obtained in practice is shown by reports, which prove that exchange faults on "Relay" private automatic exchanges are only occurring at the rate of one exchange fault per working telephone in 7.4 years, while faults on contacts are only occurring at the rate of one fault per working telephone in 40 years.

The total number of relays at Fleetwood is 12,568 for 480 lines, which is an all-in average of 26 per subscriber's line. When the exchange is increased to its ultimate capacity of 920 lines, the relays will total 22,025, or an all-in average of 24 per line. (An exchange of ten times the size, *i.e.*, 10,000 lines, would require approximately 2.5 relays per line additional.)

One of the principal features and facilities provided at Fleetwood is a combined three and four-digit numbering scheme, which illustrates one of the advantages by which the full 1,000 numbers can be employed without an additional trunking stage; the amount of equipment required is practically independent of the number of digits in the numbering scheme. The subscribers are numbered from 200 to 799, and from 8,000 to 8,319; 0 is used for trunk calls, and 9 for inquiries; 1 is not used owing to the liability of a subscriber sending a false impulse when removing his receiver from the switch-hook; if a false impulse be sent it simply resets the recorder without mutilating the call.

Another important advantage is that in searching for an idle junction in a large group, it takes no longer to search and connect the last junction than it does the first, whereas in a mechanical system the moving arm takes an appreciable time to travel over a number of engaged junctions.

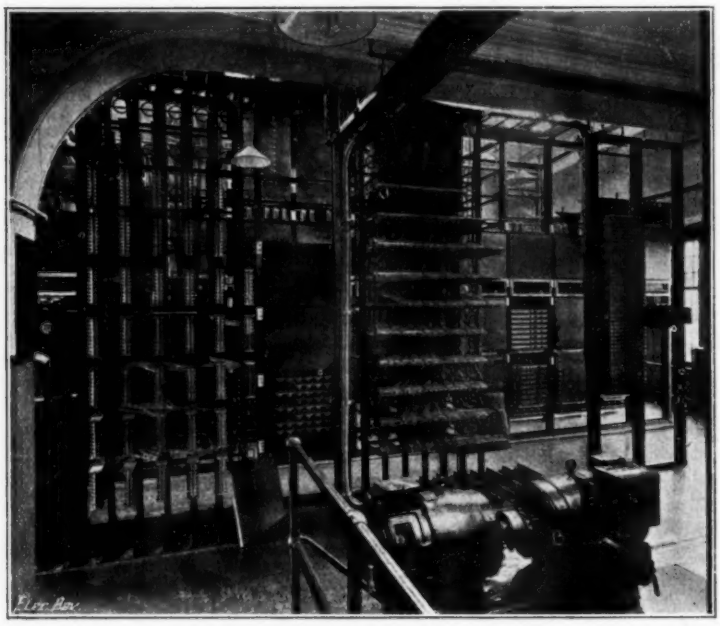


Fig. 3.—Distributive, Trunk, and Meter Racks.

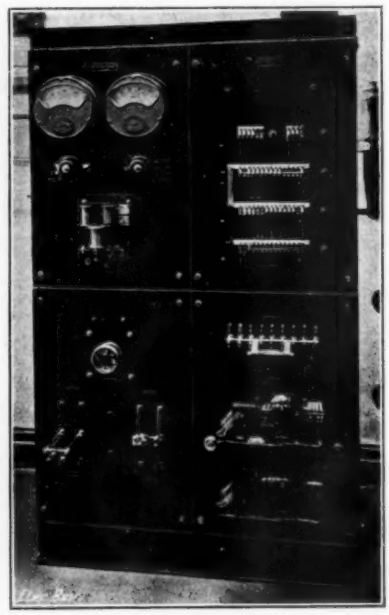


Fig. 4.—Battery-charging Board.

An intermediate distributing frame for—(*a*) distributing the traffic load on the various subscribers' groups; (*b*) distributing the traffic load on the various A and B feeds and ringing groups is provided, and the auxiliary working of subscribers' lines is effected with non-consecutive numbering and any sized group; night working is done without additional equipment.

The telephonist at the distant manual exchange controls the clear, receives the busy-back lamp-flash, and can meter the call over a two-wire junction, while trunk offering by the telephonist at the distant manual exchange is done over a special junction. Two-party-line working is arranged for.

With regard to call offices, in the case where no dial is provided the caller removes the receiver and is automatically connected over special junctions to Blackpool, where the telephonist answers and deals with the call as if it were from a call office on a manual exchange. In the cases where coin boxes are fitted the caller dials local calls direct, and on hearing the wanted party reply, deposits coins to complete the talking circuit. For calls to other districts, the caller dials 0, and the telephonist completes the connection and asks the caller to deposit the money, &c.

Thermostatic control of common apparatus, to prevent line faults and "receivers left off" from impairing the trunking efficiency of the exchange, is provided, while the delayed back-release is by thermostat.

Dialling, busy-back, number unobtainable, and ringing induction tones are provided and interrupted according to the Post Office standard; the ringing machine starts and stops automatically, and the transmission circuit includes a repeating coil and impedances, which ensure quiet and efficient transmission for long-distance working.

The busy-back is given from the A and B feed, thus reducing the load on the "in trunks." The subscriber's meter energises at the end of a conversation, and an alarm is given if it does not do so correctly; it is therefore under continuous supervision; the recorders deal with 1-, 3-, or 4-digit calls, and are not taken into engagement with a calling line until the first digit is dialled.

Traffic meters are fitted to the various groups so that a continuous record of traffic can be kept, and a recording ammeter can be fitted for speech-minute record purposes. The absence of a subscriber's multiple renders unnecessary the usual allowance of additional equipment for lapsed telephone numbers still in the directory; a subscriber's equipment has no telephone number identity until it is jumpered to the marker.

Calls for dead numbers get the NU (number unobtainable) tone, because the associated marking wires are not jumpered on the IDF, and a "changed number" bar on the latter allows calls for removed subscribers' changed numbers to obtain connection to a manual operator. A system of alarm lamps and signals indicates faults, and a simple power plant is provided, comprising two 32-volt (sixteen-cell) batteries, one charging machine, power board, and two battery-driven ringing machines.

ELECTRICAL MARKETS OF SOUTH AMERICA.

An Opening for British-made Meters.

By PERCY F. MARTIN, F.R.G.S.

In view of the wider adoption of electricity both for lighting, power, and heating purposes in the principal States of South America, the demand for electricity meters is pronounced. In these countries, fixed rates are not in favour with supply authorities, so that the provision of house-meters is general. In Argentina, a majority of these meters are intended for direct current and for 220-volt circuits, with a capacity of between two and ten amperes. Whereas in the early days the Edison meter and the Wright meter were largely used, both of these types have now been abandoned, the former surviving only in the Bastian meter, occasionally met with. In Buenos Aires, both German and Italian manufactures are popular, while in the interior cities various types of meters are used, the choice depending largely upon price and suitability.

At one time British-made electricity meters were highly thought of and generally introduced in new installations; but for some reason or other, which it is difficult to explain, these British goods have fallen from second to fourth place in the list of electrical imports, and promise to dwindle still further unless energetic steps are taken by manufacturers at home to supply the undoubted demand which exists. The steady decline in British-made meters may be traced from the early days of the war, but there seems no reason why, now that normal conditions have been restored between the United Kingdom and South America, the once considerable trade carried on in this direction should not be renewed. In comparison with the meters supplied by United States manufacturers, those from the United Kingdom were considered superior; with the revival of European activities it is doubtful whether American meters can sustain the test of quality competition. While quality is naturally greatly esteemed, the selling price is also an important factor, since the electricity suppliers—whose number is estimated at considerably over 350 in Argentina—regard the meter as an expense rather than a productive investment.

Neither is Argentina any longer entirely dependent upon foreign productions, since a local company, La Electro Metálica Argentina, turns out a considerable number of direct-current, ampere-hour meters at a very low cost, and certainly of as good a quality as any imported from Europe or the United States. Another factory, of German origin and managed by German engineers (Siemens-Schückert, Limitada), is manufacturing meters of standard types such as were formerly made in Germany and imported into Argentina by the firm referred to. The claim is put forward that between 15,000 and 20,000 of these meters have been made and sold in Argentina at prices somewhat lower than those quoted by North American or European manufacturers.

Owing, however, to the suspicion entertained against the use of ampere-hour meters on account of possible abuses in over-charging customers, new regulations have been introduced prohibiting their introduction in connection with new installations, and in some instances their removal from existing ones. The present type of electricity meter favoured in Argentina, on account of both construction and price, is the Ferraris single-phase, induction type. All meters have a cyclometer dial or a direct-reading disk dial.

In Brazil, the same objection exists to the fixed or flat-rate system as in Argentina, with the result that the market for watt-hour meters is a wide one. In this Republic also the sizes most in favour include those of a capacity of from two to ten amperes, as in the case of Argentina, while for ordinary household circuits practically all are for single phase, 120 or 220 volts, 60 cycles, which is the standard form of supply from all the larger central stations. On the other hand, there is a certain, but smaller, demand for direct-current meters

for 3-phase power meters, and for 50-cycle types. The capacity of the demand may be gauged from the fact that in the capital, Rio de Janeiro, and the next largest city, Sao Paulo, there are about 95,000 meters in use, the annual requirements being normally about 10 per cent. of this number.

European makes have hitherto held the market in competition with those of United States origin. British manufacturers have had a share in the provision of electricity meters for Brazil. It is understood that several types are being shown at the Centenary Exhibition, now in progress at Rio de Janeiro, embracing the special features desired in this tropical country and consisting in general of glass covers and ironclad conduit terminals for entrance wires, with cyclometer or direct-reading dials, the meters being so constructed as to prevent as far as possible the intrusion of tropical insects and vermin.

In Uruguay, the condition of the electricity-meter market is much about the same as in the two other States referred to, except that the purchase of all such apparatus is in the hands of the Government, which controls the generating stations. It may be said that the capital, Montevideo, offers one of the finest markets in South America for all progressive developments connected with the use of electricity, the Government taking particular pride in the character of its own show-rooms, where are displayed many admirable working models of practically every known electrical device for the factory and household.

In Montevideo, there are considerably over 30,000 consumers of the energy supplied by the Government. In view of the wide extension of residential buildings, which has been in progress for several years past, the number of new subscribers is continually being added to. The usual type of meter is for alternating current, including the Ferranti and other patterns. Some old-established installations employ the Aron meter, consisting of two electrically-driven clocks. The Shallenberger and other types are occasionally found. The most common alternating-current meters are for 220-volt, 50-cycle, single-phase circuits, having a capacity of 2½ and 5 amperes. The direct-current meters most used are for 220-volt circuits, of 2, 5, and 10 amperes capacity.

THE PHYSICIST AND THE ELECTRICAL ENGINEERING INDUSTRY.

Mr. C. C. Paterson, chief of the research organisation of the General Electric Co., Ltd., lectured before the Institute of Physics on the above-named subject on October 18th. He said that there were, in the main, three ways in which physicists might be associated with the electrical industry. First, they might work at independent investigations and research at universities with no immediate industrial objects in view; secondly, they might work with a definite industrial object at institutions outside the industry, such, for instance, as the National Physical Laboratory, and he included in this category the various industrial research associations; thirdly, they might engage in research and investigatory work with an individual company and in the employ of that company. It was the last category that he wished to consider most, not because he desired to belittle the importance of the other two categories, but because he thought the need which industry had for the physicist within itself was very insufficiently appreciated.

The electrical industry could never flourish if it relied on merely receiving the results of physical investigations from outside. The outside investigator, however brilliant and however frequent his visits to works, could never have sufficient knowledge of the industry to appreciate fully what were its real needs or what were the real facts of its problems. He wished to convince them of the urgency of the necessity for having physicists of the right sort at the heart of an industrial concern, intimately associated with its manufacturing processes and in the counsels of the management in all matters of policy which might be affected by technical considerations, and the elaboration of this aspect he took as the theme of his lecture.

He would endeavour to give as true a picture as he could of many well-managed manufacturing concerns in the electrical and allied industries. It was of no use to consider the industry as a whole. The industry consisted of a number of manufacturing units, entirely independent and generally in competition; usually the competition was in price as well as quality. Competition in quality always existed, and low manufacturing costs came only second in importance to quality. Sometimes even a compromise between costs and quality had to be admitted. Although it might not always be the case, he would assume that technical processes in the works were in the hands of men whose mental equipment was good. Often they were qualified engineers. Frequently, these men had the main executive responsibility in their departments and had to see to the putting-through of orders and the quality and design of the articles manufactured. Sometimes they were qualified men on the staff of the works chemist, or the works chemist himself was in charge of the processes. On the other hand, in some branches of the industry, a chemist was not considered necessary or was relegated to an inferior position, and the factory processes were in the hands of an engineer to whose shoulders all the production worries were transferred. In other cases, technical responsibility largely rested with the staffs of the drawing and designs office. Whoever was made responsible for factory processes and production was usually given a free hand by the management to make whatever trials and experiments he wished, with a view to improving and reducing costs. Most managements prided themselves on the encouragement given to their staffs to make experiments. This had the incidental advantage to the management of affording less ground for excuse on the part of the technical staff should processes go wrong or complaints arise. Alterations in processes or designs sometimes came from inside; often they were the result of pressure from competitors. Information, often incomplete, was received that a competitor was working along some new line, and the technical man responsible for that section was immediately set to work to reproduce the result. If he succeeded up to the point of making the new process or design an improvement over the old, it was adopted in the factory after a fairly thorough trial, and there the matter ended. There was no time for more. Empirical instructions had been given to the factory and, meanwhile, the next worry had been taken up in order of urgency. More often, the attempted improvement was discarded as unworkable for reasons which were never very clearly defined. Either it was beyond the technical skill or knowledge of the man responsible, or there were factors connected with the raw materials which were outside his control. Often improvements which were at first promising had been discarded because the results had proved erratic and uncertain in routine production, and the investigation of the causes by the usual trial-and-error methods was a task of too great a magnitude and was too expensive to face.

To a greater or less extent, this was, or had been until recently, a true picture not of one, but of the majority of the concerns connected with the British electrical engineering industry. It was also a picture of as many foreign ones. From a technical point of view it was a picture of "muddling along," frequently at low efficiency, nearly always in an atmosphere of semi-ignorance as to what it was doing, constantly fearing that the products it was supplying might develop unexpected blemishes the causes of which were shrouded in obscurity. He did not think it compared unfavourably with the average standards existing in many industrial countries throughout the world, but he was comparing it with what it was well within the power of the industry to become.

These uncertainties and mysteries in industry must be explained and for several reasons other than the obvious one. They could only be cleared up by knowing what were the physical laws which underlay its processes and governed the behaviour of its products, and this knowledge must be part and parcel of the factory equipment and must not be regarded as an academic thing, the property of one or two experts. Industry run by engineers was constantly satisfied by merely getting something to work, whether it were a process or a finished product. To do anything more was considered a waste of money. To learn the why and the wherefore was relegated by the management to universities and "places where they think." If the results of this policy were not so disastrous for industry itself, one would have little to say, but it was vital in the interests of industry itself that it should change its outlook and recognise that knowledge was as valuable to it as practical achievement. At present many concerns depended for subsistence on crumbs of knowledge picked from under the tables of the universities, and that was a meagre meal for an industry which ought to be growing. It was sometimes stated by managements that they could rub along all right with their existing technical staffs. If they came up against a problem which they could not manage, and if it was of sufficient importance, they called in outside research assistance, but this outside assistance could never take the place of the physicist at the heart of a concern.

For a works physicist to be a success, however, it was es-

sential that both the physicist and those with whom he must co-operate should learn each other's point of view. Their mentalities were different and must, and should, be different and complementary. Without this understanding there never could be fruitful work, and particularly must the works manager appreciate that the true research worker was originally-minded and therefore found control irksome. Each side must win the confidence of the other and merit the support and appreciation of the other, for the success of physics in industry depended as much upon these matters as on the actual merit of the researches carried out.

The first desideratum for the physicist was to know his works thoroughly. The physicist who entered many branches of the electrical manufacturing industry was surprised to find how empirical everything was. That the industry had been carried on successfully under these conditions was a tribute to the ability and patience of the personnel of the industry. It was a great mistake to assume that other methods could easily and quickly supersede empiricism, but they must gradually do it as principles became surely established. One of the most baffling factors in the process of substituting control by measurement for control by judgment was met with when a factory had not the full control of its raw materials, but had to take what it was able to purchase. Variations in raw materials might completely mask the effect of refinements introduced to improve efficiency. In these circumstances, there was greater need for the physicist or the works chemist, as the case might be, in order to introduce processes for the treatment of raw materials, or to show the suppliers of the raw materials what to do in order to meet requirements. The only way to expect success was to make the research physicists free-lances in the works, free to arrange their own experiments and to set themselves their own problems untrammelled by the prejudices of the existing works personnel. Their only terms of reference should be to investigate the works processes and products with a view to the improvement of efficiency and the development of better ones. They must have a laboratory of their own and workshop facilities under their own control. The number of men would depend upon the size of the concern, but two was an absolute minimum, and their qualifications would naturally depend on the particular branch of electrical engineering in question.

Many industrialists would be inclined to regard with incredulity the wisdom of letting physicists loose in their works with such a roving commission. They might see difficulties of discipline, of jealousy on the part of the works personnel, interference with production and overlapping with the duties and responsibilities of superintendents and others already responsible for experimental work. They might regard it as likely to turn into a new department responsible to none of the existing works managers, with direct access to the managing director himself over the heads of those responsible to him for the works. These were, admittedly grave considerations, but it was nevertheless of the greatest importan e to segregate the research men from the existing works influences and control and to get the managers to support and welcome this segregation.

Dealing with the application by the General Electric Co. of the ideas he had propounded, Mr. Paterson said that the company decided four or five years ago to make research one of its definite objectives. Practically the only general fundamental principle the management laid down in connection with this decision was that the research activities were to be kept independent of production activities, *i.e.*, the management must retain complete responsibility for production processes. The research organisation should assist with advice and experiment in a consultative capacity and the problems it tackled and the work it undertook must remain in the discretion of the research organisation itself. On the other hand, the decision to apply or not the results of any piece of work of the research laboratories must rest entirely with the factory concerned with the particular product. With this guiding principle and the financial means to establish laboratories, the movement was launched to work out its destiny, supported by the goodwill of the various managements—to establish its relationship with the different works of the company, and to grow as circumstances should dictate. The arrangement was absolutely flexible. Occasionally, experiments were conducted on the production plant itself—more often, if it could be arranged, the process was installed in the research laboratories where factors could be independently controlled and where production was not interfered with. Moreover, the practice had grown up of holding regular meetings of the works technical staffs with members of the research laboratory staff. Works technical matters were reviewed at these conferences, and the laboratories were able to acquaint themselves with the works policy and their urgent problems and difficulties. The whole personnel of the laboratories now numbered 80, of whom 25 per cent. were qualified research men, and of the remainder a good many were operatives who carried on some of the works processes on a small scale in the laboratory, for the purpose of studying them and applying experimental results in a practical way before recommending them to the factory.

Mr. Paterson concluded with a reference to some instances of the manner in which research work in the factory had been productive of practical results in a manner which would not have been possible otherwise. A certain process in the works which had been in use for a long time involved the coating of wires of different diameters with a material which hardened after coming out of the bath. The final product was not always uniform in quality, and there was considerable wastage due to outfalls, and consequent loss of money. Investigation showed that there were as many as six variables affecting the final product, several of them interdependent and concerning processes carried out, and products made, in different departments of the factory. One of these was the quantity and uniformity of the deposit on the wire, which became increasingly variable as the size became smaller. The problem was tackled by making measurements with a view to determining the laws governing the deposition of liquids, with and without suspensions, on long cylinders when suspensions were made. The limiting conditions were found and the lines indicated along which alone it was possible to look for success in the operation. No works technical engineer or manager would, or even could, undertake such a piece of work as this. Again, in the manufacture of a certain composite wire, the drawing process did not always yield 100 per cent. output. A bad patch was frequently met, and at these times the efficiency was very low. Careful micrographic examination of the wire at all stages resulted in the cause and remedy being found, after four or five weeks' work, and the examination revealed a condition of the wire which explained the cause of many troubles which occurred in another department of the works and had been attributed to other causes altogether. The following example was from a lamp works: The final state of evacuation of a lamp depended on the action of a certain amount of red phosphorus introduced into the lamp before sealing-off from the pump system. It was known by the elegant name of "getter." Phosphorus had been employed for this purpose for very many years in the lamp industry. For many years, also, lamp makers had rung the changes upon many different ingredients to add to the phosphorus and also upon the method of its introduction into the lamp. Nevertheless, all the lamps had not always been perfect. Many possible causes had, from time to time, been blamed for failures, including the "getter." The whole problem was clearly one of finding out thefundamental action, not only of the getter, but of every other agency in a lamp—and there proved to be several—which affected the quantity of free gas in the bulb at different periods of the life of the lamp. The whole of the phenomena were investigated and correlated in about two years and reduced to proper physical terms. The complication of the whole problem thus revealed in its full magnitude, showed the utter hopelessness of attempting to carry on manufacture intelligently by the process of groping and guessing among empiricisms.

In the design of thermionic valves, there had been the great advantage that the modern physicist was fairly early in the field and had got his principles generally clear before manufacture took place on a large scale, and it was, in this case, possible in some measure to avoid empiricism from the beginning. The same, however, did not apply to acoustics, for in spite of the fact that the telephone was one of the oldest instruments, the principles and practice underlying the faithful magnification of sounds were virtually unknown. Electrical engineers throughout the world were suddenly confronted with the necessity of supplying loud speakers in connection with the magnification and reproduction of speech and music by wire and wireless, and they had little but empiricism to go upon. The industry could only hope that the public would have patience with it until the problem had been properly explored by physicists and the results of their work translated into practice.

He could imagine few things, concluded the lecturer, more beneficial to a factory or more helpful to a progressive works staff, whether glass works, cable works, machinery works, lamp works, or any other kind of works, than an invitation from its management to a band of men, physicists and chemists, to devote themselves to its welfare and improvement, in the manner he had indicated. At the same time, he could imagine few things more disturbing than this to a works technical staff which had allowed itself to crystallise and had no real desire to depart from the methods of tradition and empiricism.

At the conclusion of the lecture, a number of lantern slides were exhibited showing the various departments of the research organisations of the Metropolitan-Vickers Co., Ltd., and the General Electric Co., Ltd. It may be mentioned that the following are included in the list of problems which the former company has allocated to its research physicists: the use of tides for power generation; critical speeds and vibration in rotating machinery; electrical and thermal characteristics of dielectrics; heat transmission and radiation of various appliances and materials used in electrical engineering; study of circuit-breaking gear by measurement of rapidly transient phenomena; and the study of stresses in gearing for power transmission.

A Large Cable.—A large cable is reported to have been constructed by the Halsingborg Electrical Works for the South Swedish Power Co. The cable, which is to be laid to the latter's transformer station in Halsingborg, is of the 50,000-V three-phase type; it has a diameter of 110 mm., and weighs about 30 kilogrammes per metre.

A MANITOBA HYDRO-ELECTRIC SCHEME.

The infinite possibilities of Canada become more and more apparent as progress is made in methods of development. The advent of electricity, employed on a scale never before known, has rendered possible the fullest exploitation of the country's vast resources which so far have been scarcely touched. Apart from this, electricity is making life easier for Canada's small population; electrical energy has received full recognition as a labour-saver, and as a clean and cheap agent for performing all kinds of duties. Canada is far ahead of the Mother Country in this respect. The principal reason of this superiority is, of course, the existence of illimitable water-power resources which are steadily being harnessed and put to work in all parts of the Dominion. We have previously said a great deal about the wonderful hydro-electric system of Ontario, but the other provinces are also carrying out schemes of equal magnitude. Already Manitoba has made several important developments, those of the Manitoba Power Co. in particular being comparable with any other hydro-electric undertaking. The province is rich in timber, coal, and copper, in addition to its fisheries and furs. In the northern part of the province copper is mined, but transport costs for the ore make the resultant price high. Timber for paper-making is also abundant, but pulping facilities are lacking, and transport costs again intervene to enhance the price of the finished product.

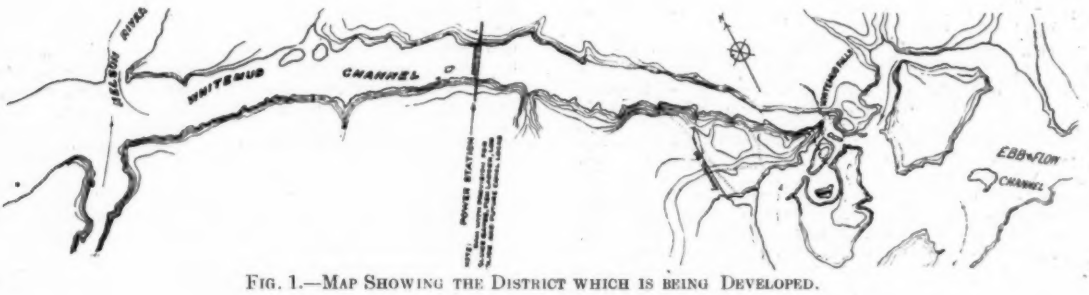


Fig. 1.—Map Showing the District which is being Developed.

With a view to developing the area and to enable copper and paper to be produced in an economical manner, a company has been formed under the title of Menzies-Smart, Ltd. This company proposes, by means of electricity produced by the power of the Nelson River, a view of which appears in fig. 2, to operate pulp and paper mills and copper smelting and refining plant, in addition to supplying energy for purposes which will follow the initial developments. As far back as 1910, the potentialities of the Nelson River were the subject of a reconnaissance survey made on behalf of the Department of the Interior. The river joins Lake Winnipeg with Hudson Bay and forms the main artery for carrying the discharge of an area of 450,000 square miles to the sea, and it runs parallel to the Hudson Bay Railway which passes within 30 miles of the power site. It flows through the central portion of North Manitoba for a distance of 430 miles, and it has a fall of over 700 ft. in this distance. The point at which the Menzies-Smart company intends to erect its station is seen on the accompanying map (fig. 1). It is proposed to utilise Cross Lake, part of the discharge of which passes over the Whitemud Falls, as a storage reservoir. The lake is not shown on the map, being over three miles distant. The company will erect a dam at a point 1½ miles below the Whitemud Falls where the width of the river is about 1,800 ft. The available head at this point is 40 ft., and the average potential power is 182,000 h.p., with a turbine efficiency of 80 per cent., corresponding to a maximum demand of 236,000 h.p., with a load factor of 60 per cent. The available maximum is 291,000 h.p. This can be augmented by means of the facilities afforded by Lake Winnipeg, which has an area of 9,414 square miles, but it is considered that this storage would not be required for many years to come. The civil engineering work to be executed will include a concrete non-overflow dam, spillways, and sluiceways at both ends of the power house, with provision for sluice gates, a fish ladder, log slides, and lockage facilities for navigation. At a point approximately three miles up-stream, at a site known as Eve's Falls, will be placed a rock-fill diversion dam of the free spillway type to cut off the flow through a waterway known as Eve's Channel, thus providing an automatic spillway 2,000 ft. in length. It is stated that no unusual engineering difficulties will be encountered in carrying out the hydraulic work.

At each end of the power house will be placed six sluices, each 20 ft. wide, separated by 6-ft. piers, and a sill provided with stop logs or gates to control the flow of the river. From the end of the sluice-way will extend a free spillway, with a total length of 316 ft. At the extreme end of each spillway a non-overflow dam will be built to restrict "flood waters." The entire structure will be of solid cyclopean concrete, reinforced where necessary.

In the generator room of the power house, the generators, turbine governors, and exciters will be installed. The turbines which it is proposed to employ are of the vertical shaft, single runner, high-speed Francis type, made by Messrs. Vickers, Ltd. The weight of the rotating parts will be borne by a Michell suspension bearing mounted on the top of the generator. The runners, movable gates, fixed guides and other exposed parts will be of extra heavy construction to guard them against the effects of block ice which may float in if the racks are raised for any purpose, and will be fitted with the latest devices for combating frazil ice. The speed of the turbine will be controlled by an automatic oil pressure governor. Each governor will be supplied with oil from valveless pumps, the pressure system being in duplicate. There will be a central supply for all governors, and an individual, independent, supply for each, with compressed air accumulators. The governors will have all adjustments readily accessible, and the speed will be controlled from the switchboard. An excess speed cut-out which will close the turbine gates immediately and automatically will be fitted. The turbine gates will be fitted with both hand and motor-driven closing gear. Each turbine operating under a 40-ft. head will be capable of giving a maximum output of 23,000 h.p. The generators will be 3-phase, 60-cycle machines delivering current at 12,000 V. Each will be provided with an exciter directly-connected to its shaft. The normal rating will be 15,000 kW and the machines will be capable of sustaining a continuous overload of 25 per cent. The transformers for long-distance transmission will be single-phase, each of 5,000 kVA normal rated capacity and designed to withstand safely 50 per cent. continuous overload. These will step-up the pressure to 110,000 volts, but provision will be made to tap off energy at

Fig. 2.—The Nelson River.

lower pressures. These transformers will not be required in the initial stage as the energy will be transmitted direct to the mills at the generated voltage. A double-circuit three-phase transmission line, arranged for 110,000 volts, will be erected. For the initial installation, however, it will be operated at 12,000 volts.

The total cost of the initial portion of the scheme, giving 48,000 h.p., is put at $4,028,500; the final development of 291,000 h.p. will cost a further $6,600,000.

At the same time as the first stage of the power scheme is being put through copper smelters will be erected. These will take the whole of the power generated. Later a 43-mile electric railway will be constructed to link up with the Hudson Bay Railway, and pulp and paper mills will be erected.

Previous experience has shown that such schemes in Canada have formed the nucleus of large townships, and the same is anticipated in connection with this development.

NON-MAGNETIC CAST IRON.

A Dawson-Ferranti Patent.

The necessity for a metal having similar magnetic properties to brass and gunmetal, but in price more nearly approaching that of cast-iron, has long been felt by manufacturers of electrical plant and apparatus. Such a product is now on the market under the name of "No-Mag," an alloy which possesses not only the features of gunmetal, which are so essential in the design and construction of electrical machinery, but also has a higher specific resistance than ordinary cast-iron. "No-Mag," therefore, combines at once the essential non-magnetic properties of gunmetal and the high-resistance properties of cast-iron, and its use permits enormous advantages to be gained when magnetic hysteresis is removed and loss due to eddy-currents is reduced to a minimum, benefits which are not jointly obtainable with any other metal or alloy in use. This combination is readily observed on reference to the following figures:—

	Magnetic Permeability. Maximum	Specific Resistance. Microhms per cm. cube.
Cast-iron	330.00	95.0
"No-Mag" ...	1.03	140.0
Brass	1.00	7.5

This invention was prompted by a close consideration of the incompleteness of existing materials in this respect, especially with reference to cases wherever there is present an alternating or rotating flux. By its use in the construction of an alternator the hysteresis and eddy losses in the stator and plates are reduced to a minimum, and magnetic leakage

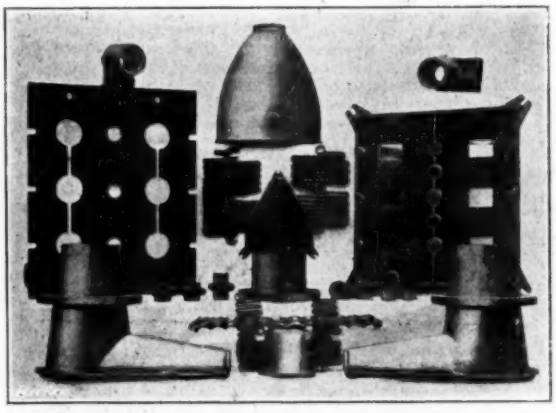


Fig. 1.—"No-Mag" Castings.

is largely removed; the same applies to the covers over the end connections. In the case of armatures or rotors of direct and alternating generators or motors if non-magnetic iron end plates are used the total flux is kept particularly confined to the armature core and magnetic leakage is again reduced to a minimum, the latter being important from the point of view of the reduction in the amount of copper which may be used.

The main characteristics of non-magnetic cast-iron are, as seen from the table already given, as follows:—

(1) *Low Magnetic Permeability.*—The figure is approximately the same as that for air, namely, unity. Repeated tests show a permeability for this material of 1.03, which, it will be observed, is practically the same as for brass, which is 1.00.

(2) *Temperature Effect on Permeability.*—"No-Mag" is slightly less permeable with increasing temperatures, as shown by the following figures actually obtained on test: At 17 deg. C., permeability 1.025; at 100 deg. C., permeability 1.020. This property of low permeability enables "No-Mag" to be used in place of brass, especially where there is danger of undesired eddy currents, and its uses in this direction cover a large field.

(3) *Specific Resistance.*—"No-Mag" has a much higher specific resistance than ordinary cast-iron. Its resistance of 140 microhms per centimetre cube, as compared with 95 for ordinary cast-iron, shows an increase of 50 per cent., and suggests the use of this material in cases where increased resistance with smaller volume of metal, or similar resistance with extra metal for strength, would be an advantage, such as in resistance grids.

(4) *Resistance Temperature Coefficient.*—Between 0°C. and 100°C. this is 0.0009 per 1°C., as compared with approximately 0.0019 per 1°C. for ordinary cast-iron, the respective formulæ being: "No-Mag" iron $R_2 = R_1 (1 \times 0.0009\ t°C.)$; ordinary iron $R_2 = R_1 (1 + 0.0019\ t°C.)$.

Manufacture.—"No-Mag" can be cast with the same facility as ordinary cast-iron, brass, and aluminium, and has the same appearance as the former, with which it also compares equally as regards strength and machining properties. In tensile and transverse strength it follows the usual cast-iron figures, but has the advantage of increased toughness and malleability, which is observed both in the transverse deflection and in its resistance to shock. This property will commend itself as being especially useful in the case of resistance grids.

The increased toughness of the new metal as compared with ordinary cast-iron is also shown by the Izod test, figures for which are as follows (compared with the same figures for two samples of ordinary cast-iron): For this purpose the test was developed on a larger bar than usual, in order to show up more clearly the differences between various grades of cast iron:—

		A.	B.
Cast-Iron	Carbon ... ... =	3.36	3.38
	Silicon ... ... =	1.81	1.99
	Phosphorus ... ... =	0.46	0.79
	Tensile Strength (tons per square inch) ... =	14.90	14.10
	Izod (foot-lb.) ... ... =	14.00	11.00
"No-Mag"	Izod (foot-lb.) ... ... =	29.00	

The Izod test bar was 20 mm. x 20 mm. x 75 mm.

The cost of "No-Mag" depends somewhat, as does that of ordinary cast-iron, on the type of casting into which it is put, but can be taken as being between 20 and 50 per cent. higher than that of grey iron. When compared in price with gunmetal, however, its use as a substitute for that material becomes obvious, its cost being about half.

To point out only a few of its fields of usefulness we might mention oil-switch covers, busbar clamps, brackets, cable boxes, sealing bells, bearing covers, separating pieces, transformer covers, &c., resistance grids for tramway or other electric vehicles, and in all cases where such grids are used, allowing either for an increased resistance to be obtained for the same weight of metal employed, or lower temperature rises for the same current-carrying capacity on account of the increase in metal which can be employed without impairing the resistance value. The new product, which is made by Messrs. Ferranti, Ltd., under a Dawson-Ferranti patent (application No. 33,290/20; U.S. patent No. 517,777/21), is also made in the form of "pig" metal, which is ready to charge directly into the cupola or other melting furnace.

THE ELECTRICAL POWER ENGINEERS' ASSOCIATION.

Annual Dinner.

On Saturday last the fourth annual dinner of the Southern Division of the Electrical Power Engineers' Association to the members of the National Executive Council was held at the Hotel Cecil. The chairman was Mr. W. J. Oswald, A.M.I.E.E., senior vice-president, and there were present about 180 members and guests, including ladies.

After the loyal toast had been honoured, Mr. Frank Gill, president of the Institution of Electrical Engineers, speaking for the first time in that capacity, proposed the toast of "The Association." He said he had strong reasons for believing that the Association was doing very fine work. By adhering to the Whitley scheme and working on constitutional method it was benefiting the electricity supply industry, which above all was a key industry. It was also carrying on an educational campaign and was evolving a scheme of training for newcomers into the industry. He advocated discretion in appraising the qualifications of a candidate for membership—Faraday and Stephenson were not qualified engineers, and they must be careful not to exclude desirable men. In connection with training, ideals were important—the things that made character; they needed men of reliability, based on a sense of duty and a spirit of self-sacrifice.

Mr. T. A. G. Margary, junior vice-president of the Association, proposed "Kindred Associations" in a humorous speech, referring to the discovery of the Association that it had

kinship with hundreds of trade unions, including the professional associations.

Mr. J. R. Bowden, vice-chairman, proposed "The Ladies," whom he thanked for the help they had given to the Association in its work, and the sacrifices they made on its behalf.

Mr. W. J. Oswald, chairman, proposed the toast of "The Visitors," claiming that the presence of so many distinguished guests was a striking testimony to the position that had been attained by the Association. Amongst those present were Mr. Page (one of the Electricity Commissioners), Mr. Gill (president I.E.E.), Mr. W. C. Ullman (president Associated Municipal Electrical Engineers), and Mr. Latham (president of the National Federation of Professional, Technical, Administrative and Supervisory Workers). He expressed deep appreciation of the work done and time given by the provincial members of the National Executive Council, and thanked the Electricity Commissioners for their assistance and support; they also could help the Commissioners and would stand by the industry in times of political strife. The Association, he said, was really in earnest with regard to the education and training of engineers, and he appealed for the support of the chief engineers to further that end The full significance of the Federation of Professional Workers had not been fully realised; it would become a potent force in the social and industrial work of the country, and would exercise influence for the protection of professional men. The continued existence of the National Joint Board was more necessary to the employers than to the E.P.E.A.—if the Association concerned itself with selfish aims it would let the Board go. He appealed to employers to support the Board; to withdraw from it was a suicidal policy, and would lead to a struggle which would not benefit the industry at the present, though it would make for its ultimate good. The Association owed much to the technical Press for its kindly help and friendly criticism, which was accepted as well-meant even if they did not agree with it. Mr. Oswald also thanked the lecturers who had assisted them, and declared that the members were proud of their profession, of their work, and of their Association. On the proposal of Mr. Heaviside, the health of the chairman was drunk, with musical honours, and briefly acknowledged. Mr. W. J. Jeffery then, on behalf of the members, invited Mr. Heslop to accept a present comprising a silver tea set, a canteen of cutlery, fish servers, fruit knives, &c., and a special gift of jewellery for Mrs. Heslop (who was not present), in recognition of the great work which he had accomplished during his year of office as president—although, living at Barrow, he had to travel 200 miles to the Council meetings, and covered 20,000 miles last year on E.P.E.A. business. Mr. Heslop had reorganised the finances of the Association and rekindled enthusiasm, and had initiated a sound policy of agreement and co-operation with the manual workers' unions, two achievements which stamped his year of office as a most notable one; and Mrs. Heslop had loyally supported him in the work in spite of his frequent absences and the resulting disorganisation of home life.

Mr. Heslop briefly responded, expressing his thanks for the presentation and for the terms in which it had been made.

Replying to the first toast, Mr. Jeffery said that the Association had found that organisation for self-protection brought with it new responsibilities—(1) To the public in general and the electricity supply industry in particular; the E.P.E.A. had been the bulwark which enabled supply to be maintained without interruption for some years. (2) To the employers; the Association meant to see that the status of engineers was raised, and this meant raising the standard of training of new men. (3) To themselves; engineers did not fully recognise their own importance to the country—no profession was of such value to the nation as that of electrical engineer. The Royal Charter obtained by the I.E.E. was a most important step towards public recognition. (4) To the men under their supervision; they must educate them to a proper appreciation of their duty to the world at large. "Ca'Canny" was the result of ignorance, and the staff unions could remedy that condition.

Major F. H. Masters (editor *The Electrician*) responded on behalf of the visitors, suggesting that if the Press was the fourth estate of the realm, electricity supply was the fifth, and that it was the duty of the Press and of the Association to urge on the utilisation of electricity by every possible means.

Mr. R. R. Telford (of the National Executive Council) expressed the N.E.C.'s appreciation of the honour done to them, but held that it was really the dinner of the Association, not merely of the Southern Division.

Mrs. Oswald, replying for the ladies, expressed the view that there were not enough social functions in connection with the Association; such occasions would arouse the interest of the ladies, who had to spend much time alone owing to the calls of the Association's work.

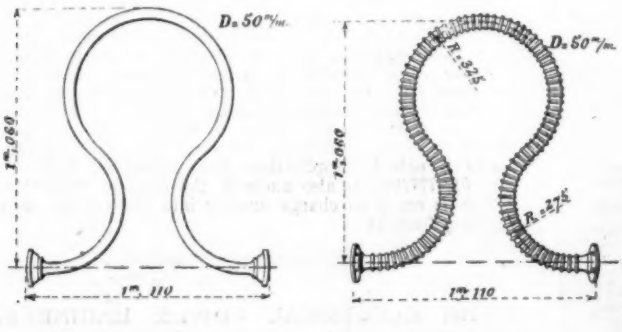
Mr. G. Latham (president Federation of Professional Workers) replying on behalf of the kindred associations, said the aim of the Federation was to advance the interests of the great body of "black-coated workers," and commended the courage and ability shown by the E.P.E.A. in pursuing its policy.

Finally, the chairman expressed deep indebtedness of the gathering to the Dinner Committee for the excellent arrangements that had been made, with special reference to the work of Mr. P. G. Hieatt, hon. secretary of the Southern Division.

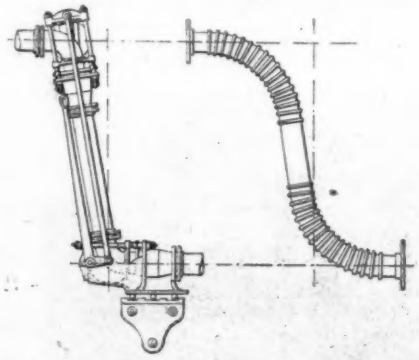
A musical programme was interspersed with the toasts, and the function was in every respect successful and thoroughly enjoyable.

CORRUGATED STEEL PIPES AND TUBES FOR FLUIDS AT HIGH PRESSURES.

For some time past corrugated steel tubes have been largely used instead of expansion joints for protecting pipe-lines, not only from expansion and contraction, but also from vibration. The corrugated pipe differs from the ordinary pipe of uniform cross section, as shown in figs. 1 and 2. The corrugations or waves occur at regular intervals, varying according to the diameter of the pipe, its thickness, and the use to which it is put. The inner side of the corrugations is tangential to an ideal cylinder of the same diameter as that of the original tube. The pipes are manufactured by taking an extra-mild steel smooth pipe and making the corrugations with the metal in the hot state. The operation of corrugating the pipe forms, at the same time, a selective test for the smooth pipe, since a pipe of inferior quality could not stand the work of deformation necessary.



Figs. 1 and 2.—Smooth and Corrugated Expansion Bends.



Figs. 3 and 4.—Expansion Joint and Corrugated Coupling Pipe.

Among the advantages of these corrugated pipes may be mentioned: (*a*) greater elasticity in the longitudinal direction; (*b*) greater resistance to internal or external pressures; (*c*) the ease with which the pipes may be bent through any angle.

Corrugated pipes can be used for obtaining a flexible joint in steam and high-pressure gas lines subjected to alternating stresses of tension and compression, due to temperature variations or other causes; and as shock or vibration absorbers.

According to the *Génie Civil*, from which these particulars are derived, in the method of manufacture adopted by a large French firm, any diminution in wall-thickness of the pipe is automatically excluded. To bend the pipes they are first of all raised to red heat without filling with sand, &c., after which the portion beyond the bend is sprayed with a fine jet of water to make it undeformable. The pipe is then bent by compression on a mandrel. Corrugated pipes may be bent and re-bent in the cold state through a small radius without cracking the metal.

Figs. 3 and 4 show the application of a corrugated tube to the compensation of a steam pipe-line, the left-hand illustration showing the old form of compensator with stuffing box and

hinges, and the right-hand figure the simple S-bend of corrugated piping which takes its place. The trouble with the previous forms of compensator was that they were liable to stick, due to expansion, and were easily scored by grains of sand or other foreign substances, thus giving rise to leaks. In the corrugated pipe compensator all fatiguing of the metal is reduced to a minimum, and accidents are practically excluded. Where used as water and flame tubes in boilers, corrugated tubes take up the variations in contraction and expansion, and thus save fatigue in the tube-plates,

E. S. H.

LEGAL.

Charge of Abstracting Electricity from Main.

At Burnley, on October 25th, George Gregson, a tradesman of Berkeley Street, pleaded not guilty to abstracting electricity from a main. He was allowed a supply for power purposes, but not for lighting. On the meter being examined it was found that a piece of wire had been connected between the fuse-box and an electric light in the shop. Defendant said he thought the current was being registered. Fined £5 and costs.

An Electricity Supply Company and an Agreement.

Counsel were heard in the Court of Session, Edinburgh, last week in an application by Duncan's Electricity Supply Co., Ltd., 1, Golden Square, Aberdeen, in accordance with Section I. (1) (a) of the Courts (Emergency Powers) Act of 1919. The company had entered into an annual agreement with the Provost, Magistrates, and Councillors of the Burgh of Ballater for the supply of electricity, and this agreement it was now sought to suspend or annul, owing to the alteration of trade conditions due to the war.

The applicants, a private company, with capital of £25,000 in £1 shares, became undertakers under the Ballater Electric Lighting Order of 1914, which was secured in agreement with the respondents by Mr. James Duncan, of Tillycorthie. The company commenced to generate electricity in 1914, but during the period from 1914 to 1917 the work was retarded owing to the war conditions of lighting restriction and the high cost of production. Similar conditions prevailed the following year, and in October, 1918, the company told the Town Clerk that it proposed to increase the lighting rate from 6d. to 8d. a unit and the power rate from 2d. to 3d. The Town Council acquiesced in the increases and these rates still remained. It was explained that the works, although economically managed and efficient, had not allowed the company ever to pay a dividend, to set aside a sum to meet depreciation, or to pay a salary to its manager or its supervising engineer. It had a debt for repairs for £1,016. At the present rates charged the expenditure on the undertaking would, in any normal year, exceed the revenue by £477. This excess was entirely due to the alteration of trade conditions through the war. In these circumstances the company in 1922 applied to the Ministry of Transport for an Order to increase the maximum prices allowed by the existing Order to 1s. for lighting and 5d. for power. The annual revenue would then have exceeded the expenditure by only £54. The application was opposed by the Town Council, who contended that the minute of agreement had not expired, that they believed that Mr. Duncan did not intend to make a profit from the undertaking, and that they were paying rates which met the increased cost of production. The company asked the division to suspend or annul the agreement.

The division held that the application was relevant, and ordered an inquiry before one of the judges. The question of expenses was reserved.

Charges Arising out of a Scottish Colliery Explosion.

As a sequel of the explosion at Viewpark Colliery, Uddingston, on April 11th last, when two men were killed, and the subsequent inquiry under the Fatal Accidents Act, the Crown instituted proceedings against Thomas Weir, Bothwell, and Andrew Crowe, Bothwell, the manager and under manager respectively of No. 1 pit, Viewpark Colliery, and George Thom, Uddingston, the chief electrician at the colliery. The manager and under manager were charged with five offences under the Coal Mines Act, 1911—allegations being made that they failed to observe certain regulations concerning ventilation and the use of electricity under conditions which rendered it dangerous. The electrician was charged with having failed to have the electrical apparatus in the splint coal seam constructed, installed, protected, worked, and maintained so as to prevent danger so far as reasonably practicable, in that he failed to have in position three stud bolts for holding down securely a coal-cutting machine cover and seven stud bolts in a switch casing. The three accused were defended by Mr. Graham Robertson, K.C., while Mr. Wm. Thomson, Procurator-Fiscal, had charge of the case for the Crown.

The case against George Thom was called first.

Joseph Lynch, Bridgeton, Glasgow, stated that on the night of April 10th-11th he was in charge of a coal-cutting machine along with Bernard Finnigan. They had three electric lamps. He was familiar with the machine, and on that night it worked perfectly. Usually the switch cover of the machine was held down by four bolts, but these were missing. There were holes in the covers for studs, one of which was out, and though the hole the switch could be seen. He had complained of the machine on April 7th, and it was repaired by the electrical staff. Witness resumed the use of it on April 9th, when it heated up, and it was again reported for repair. The defect was remedied, and on the 10th it worked well until the explosion next morning at 7.30. The explosion occurred just as his neighbour turned on the switch for the last time.

In cross-examination, witness said he was not aware of the rule that all machinemen must carry oil safety lamps, and no instructions came to him in January to that effect. He never saw a machineman with an oil safety lamp during all his time at the pit. He could not definitely say that all the four holding-bolts of the cover were missing. He denied that when the machine was repaired the bolts were in position, and that he or Finnigan, or both of them, removed the bolts in order to lift the cover.

Bernard Finnigan corroborated the previous witness. He said that two bolts were missing, and through a hole caused by the absence of a stud he could sometimes see a flash when the switch was turned on. He, too, admitted that he had never asked for oil safety lamps.

Asked by counsel if the accident which occurred on the morning of April 11th was not just an ignition rather than an explosion, the witness replied that he was thrown back by the force of it but not knocked down. He denied having interfered with the bolts of the machine during the night.

George Chalmers, assistant electrician, Bothwell, spoke to having carried out repairs on the machine with a fellow electrician on each occasion complained of by the witness Lynch. Mr. Thom had the matter reported to him, and on the day previous to the accident he accompanied witness to the machine and saw the defect put right. He was positive that all the bolts and studs of the switch cover were replaced before the machine left their hands. There might have been a few bolts missing from the oil-box cover, but that was immaterial. On April 10th, when Mr. Thom was at the machine, he took a spanner from witness in order to tighten the switch cover bolts. After the accident three of these bolts were missing, and also some of the studs.

In cross-examination, the witness said it was his opinion that the bolts and studs could not have come out owing to the vibration of the machine. They must have been interfered with, and there were several reasons for taking off the cover. The operators might have wished to clean the switch fingers for instance.

Wm. M'Laughlin, assistant electrician, who partnered Chalmers in repairing the machine, gave corroborative evidence

The accused in the witness-box maintained that the machine was fully provided with all the necessary studs and bolts.

His Lordship, without calling upon counsel for the defence, said he was prepared to give his decision at once. He thought it was quite proper to bring such a case because matters of that sort should be fully investigated in the interests of the safety of the miners. He had, however, simply to decide between two sets of witnesses—the two men who were in charge of the machine and the three electricians. Neither set was disinterested. Both had an interest in acquitting themselves of any responsibility for the explosion, and it occurred to him while he was hearing the evidence that the machinemen might as well have been in the dock as the present accused. Taking the evidence as between the two sets of men, he was bound to say that he preferred that of the electricians. He was very favourably impressed with the way they gave their evidence. There was no attempt to suggest that everything was perfect, as there was an admission that bolts were wanting in places where they were unessential. He thought the men, as practical electricians, had devoted all their attention to seeing that the essential parts were kept in repair. His view of the evidence was that the accused was entitled to a verdict of " Not guilty " and not merely one of " Not proven."

The trial of the manager and under manager was thereafter adjourned till November 8th.

British Thomson-Houston Co., Ltd., *v.* B.T.T. Electric Lamp & Accessories Co.

In the Chancery Division, on Tuesday, the B.T.-H. Co., Ltd., were plaintiffs in a motion for judgment in default of defence against Blanche Clara Taylor, William Taylor, and the B.T.T. Electric Lamp & Accessories Co., of Crutched Friars, for an injunction restraining infringements of letters patent for improvements in evacuated vitreous containers.

Mr. Trevor Watson (for the plaintiffs) said the defendant firm had entered an appearance, and had pleaded that the only partner was Mrs. Taylor, but the plaintiffs desired separate judgments against the firm in the ordinary form. There had been separate infringements, and there should be separate judgments.

Mr. Justice Romer: Yes, as to damages, but not for infringement.

Mr. Watson said they wanted to take action against separate members of the firm, if there were any.

His Lordship said he would give judgment for the plaintiffs by consent against Mr. Taylor, but he would give no relief as against Mrs. Taylor.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

27,918. "Spring contacts for electric switches, fuse-holders, &c." A. C. Smith. October 14th.
27,928. "Wireless receiving sets." C. B. Kersting. October 14th.
27,951. "Asynchronous electro-motors." L. Segal. October 14th.
27,961. "Vacuum tubes." E. Y. Robinson. October 16th.
27,982. "Thermionic devices." E. Y. Robinson. October 16th.
27,977. "Crystal detectors for wireless telegraphy." A. Adams, W. G. Hughes, and H. L. Jackson. October 16th.
27,985. "Electric hammer." A. E. W. Maseyk. October 16th.
28,002. "Intervalve couplings for wireless installations." R. Heather, N. Miles, and Wireless Instrument Manufacturing Co. October 16th.
28,010. "Electric signs." P. Freedman. October 16th.
28,014. "Radio-telephonic receivers." A. E. Alexander (Cory & Son, Inc.). October 16th.
28,025. "Electrolytic rectifiers." M. A. Codd. October 16th.
28,037. "Electric lighting devices." J. P. Haworth. October 16th.
28,042. "Electric switches and plug couplings." G. Marr. October 16th.
28,054. "Electric impulse distributing systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). October 16th.
28,062. "Fittings for electric lamps." J. H. Collings and M. J. Railing. October 16th.
28,077. "Telautography." H. G. Bartholomew and M. L. D. McFarlane. October 16th.
28,078. "Telautography." H. G. Bartholomew and M. L. D. McFarlane. October 16th.
28,083. "Recorder relay." W. P. D. Van der Knapp. October 16th. (Holland, December 16th, 1921.)
28,086. "Head attachment gear for telephone receivers." British Thomson-Houston Co., Ltd. October 16th.
28,092. "Electric light globe attachments." E. W. Hutchings. October 16th. (New Zealand, October 18th, 1921.)
28,098. "Electric snap-action switches." Ward Leonard Electric Co. October 16th. (United States, July 29th, 1921.)
28,099. "Controllers for electric circuits." Ward Leonard Electric Co. October 16th. (United States, July 29th, 1921.)
28,100. "Photo-electric device." T. W. Case. October 16th.
28,103. "Electrically-heated cooking devices." W. J. Mellersh-Jackson (J. F. Newsom). October 16th.
28,115. "Relays." A. L. Rawlings. October 16th.
28,124. "Synchronisation of clocks by wireless waves." A. E. J. Ball and I. H. Parsons. October 17th.
28,152. "Electric heating device for incubators, &c." G. W. Phipps. October 17th.
28,154. "Fitting for use with electric light terminal to produce a light of low candle power." J. Bradley. October 17th.
28,155. "Electric switchgear." Brook, Hirst & Co., Ltd., and J. A. Hirst. October 17th.
28,165. "Electric advertisement sign." R. Osborne. October 17th.
28,169. "Sparking plugs." H. C. Brown. October 17th.
28,189. "Apparatus for production of changeable electro-luminous effects." L. C. Pla. October 17th.
28,190. "Electric interrupters." A. B. Pales. October 17th. (Spain, June 13th.)
28,193. "Electric riveting." G. B. Ellis (T. E. Murray). October 17th.
28,200. "Controllers for electric control systems." Metropolitan-Vickers Electrical Co., Ltd., and N. E. North. October 17th.
28,223. "Electric lamps." A. Smith and T. G. Thomson. October 17th.
28,232. "Burglar alarms." A. O. Ward. October 17th.
28,235. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). October 17th.
28,238. "Electric plug socket." H. Baron (F. Allendorff). October 17th.
28,242. "Apparatus for electrolysis of metals." A. Cremer. October 17th. (Belgium, October 18th, 1921.)
28,252. "Devices for protection of windings of high-voltage telephonic apparatus." W. J. Rickets. October 18th.
28,277. "Electrically-operated lock for doors, windows, &c." W. J. H. Walter. October 18th.
28,281. "Earthing of electrical apparatus." F. W. Rowley and A. W. Williams. October 18th.
28,286. "Electric conductors." E. L. Liley. October 18th.
28,322. "Vacuum tubes, &c." E. Y. Robinson. October 18th.
28,323. "Thermionic devices." E. Y. Robinson. October 18th.
28,324. "Antenna systems for wireless communications." E. Y. Robinson. October 18th.
28,325. "Thermionic devices." E. Y. Robinson. October 18th.
28,326. "Thermionic devices." E. Y. Robinson. October 18th.
28,336. "Electrolytic anti-corrosion systems." A. S. Gush. October 18th.
28,343. "Wireless current rectifier." L. Lochner. October 18th.
28,350. "Electric incandescent lamps." General Electric Co., Ltd., and C. J. Smithells. October 18th.
28,351. "Electric incandescent lamps." General Electric Co., Ltd. October 18th. (Germany, October 19th, 1921.)
28,367. "Variometers." United Manufacturers & Agency, Ltd. October 18th.
28,386. "Electric plug and socket unions for lamps." A. L. Davis. October 18th.
28,389. "Aircraft lamps." A. Davis. October 18th.
28,393. "Relays for reproduction of sound, &c." F. W. Baynes. October 19th.
28,407. "Sparking plugs." T. Foster and G. Thomlinson. October 19th.
28,422. "Electric kettle." C. de C. Matulich. October 19th.
28,423. "Crystal rectifiers for wireless telegraphy." L. B. Miller. October 19th.
28,432. "Control device for wireless telegraphy, &c." A. J. Bull. October 19th.
28,444. "Radio telephonic, &c., systems." A. J. Hurst and H. J. Lucas. October 19th.
28,449. "Steam turbines." English Electric Co., Ltd. October 19th.
28,451. "Apparatus for electrical transmission of power." K. R. D. Shaw. October 19th.
28,473. "Electric ignition, &c., apparatus for internal-combustion engines." G. Unterberg. October 19th. (Germany, January 12th.)
28,474. "Pressure regulator for ignition apparatus." G. Unterberg. October 19th. (Germany, December 19th, 1921.)
28,488. "Electric control systems." British Thomson-Houston Co., Ltd., R. D. Given, and E. G. James. October 19th.
28,493. "Electric relays." W. H. Anthorpe and Cambridge & Paul Instrument Co., Ltd. October 19th.
28,497. "Electric switches." Akt. Ges. Brown, Boveri et Cie. October 19th. (Switzerland, November 3rd, 1921.)
28,499. "Electro-magnetic separation or concentration of minerals." W. M. Mordey. October 19th.
28,504. "Telephone system." Automatic Telephone Manufacturing Co., Ltd. October 19th. (United States, February 4th.)
28,515. "Commutators for motor vehicles." E. L. Ostara. October 20th.
28,520. "Luminous signs." A. Amos and W. Stephen. October 20th.
28,521. "Apparatus for testing coil ignition systems of internal-combustion engines." H. E. Coston and E. A. Miller. October 20th.
28,533. "Means for controlling electrically-operated mechanisms, &c." F. Whipp and Whipp & Bourne, Ltd. October 20th.
28,553. "Grooved tramway rails, &c." J. P. Barker. October 20th.
28,556. "Gas and electricity meters, &c." P. F. E. Major, G. H. Miles, and C. Coates-Smith. October 20th.
28,572. "Magneto ignition for internal-combustion engines." D. Dunnett, Research Association of British Motor and Allied Manufacturers, and H. S. Rowell. October 20th.
28,574. "Circuit breaker for electric installations." L. Jublin. October 20th. (France, November 8th, 1921.)
28,590. "Diaphragm for telephone receivers, &c." H. J. Bailey. October 20th.
28,592. "Measurement of X-radiations." C. E. S. Phillips. October 20th.
28,604. "Manufacture of telephone cables." Johnson & Phillips, Ltd., and C. F. Street. October 20th.
28,624. "Alternating-current commutator machines and methods of starting them." F. Creedy. October 21st.
28,663. "Electric conductor." H. A. O'Neil. October 21st.
28,669. "Electric cut-out." W. H. Illingworth. October 21st.
28,670. "Apparatus involving the use of a number of electric cutouts." W. H. Illingworth. October 21st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

9,536. "Control systems for direct-current electric motors." J. A. M. De P. Givelet. March 31st, 1921. (186,640.)
10,310. "Electrical means for transmitting and reproducing sound." A. F. Sykes. June 2nd, 1921. (Addition to 160,223.) (186,658.)
16,294. "Device for testing high-tension sparking plugs, magnetos, and coils." J. J. Jennison and P. Greenhalgh. September 28th, 1921. (186,663.)
17,106. "Photographic recording and electric signals." J. Hettinger and C. A. Vandervell & Co., Ltd. June 22nd, 1921. (186,665.)
17,361. "Means for preparing, transmitting, and recording messages, particularly applicable to telegraphy." A. C. Baronio. June 24th, 1921. (186,670.)
17,025. "Diaphragms for sound-recording and sound-reproducing instruments." W. E. Clifton and Cliftophone, Ltd. June 27th, 1921. (Cognate application, 24,324/21.) (186,672.)
17,024. "Diaphragms for sound-recording and sound-reproducing instruments." W. E. Clifton and Cliftophone, Ltd. June 27th, 1921. (Cognate application, 28,347/21.) (186,673.)
17,036. "Electric heaters." L. M. Waterhouse and F. F. D. Davidson. June 28th, 1921. (186,675.)
17,708. "Electrical distributing apparatus for explosive motors." V. Paquit. August 17th, 1920. (168,041.)
17,748. "Electric apparatus for sending out the time." M. P. Favre-Bulle. June 29th, 1921. (186,681.)
17,752. "Method of and apparatus for producing optical signals of a definite colour." Siemens & Halske Akt. Ges. September 18th, 1920. (169,430.)
17,820. "Dynamo-electric machines." A. H. Midgley. June 30th, 1921. (186,684.)
17,893. "Ironclad electrical switches." Midland Electric Manufacturing Co., Ltd., and W. L. Barber. July 1st, 1921. (186,689.)
17,959. "Telephone switch-banks." Creed & Co., Ltd., and T. Lenaghan. July 1st, 1921. (186,694.)
18,032. "Electrically-heated clothing." A. Negromanti. December 18th, 1920. (173,205.)
18,062. "Electrical protective apparatus." A. H. Railing, C. C. Garrard, and W. Wilson. July 4th, 1921. (186,699.)
18,108. "Electric supply services for dwelling-houses." E. S. Russell. July 4th, 1921. (186,703.)
18,122. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. July 3rd, 1920. (186,796.)
18,156. "Changeable advertising device." G. J. Motter. July 5th, 1921. (186,706.)
18,240. "Telephone circuits." Siemens Bros. & Co., Ltd., and D. A. Christian. July 6th, 1921. (186,713.)
18,964. "Electric switchgear." W. A. Coates, G. E. Gittins, D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. July 13th, 1921. (186,733.)
19,961. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 11th, 1921. (174,035.)
20,384. "Telephone systems." Western Electric Co., Ltd. September 25th, 1920. (169,684.)
20,545. "Electrically-operated warning horns." R. W. Maudsley and Standard Motor Co., Ltd. August 2nd, 1921. (186,758.)
21,114. "Link boxes for electrical mains." F. Thursfield and G. P. Cosway. August 9th, 1921. (186,768.)
21,933. "Electric motors." T. Yamamoto and M. Kawarada. December 7th, 1920. (172,603.)
22,026. "Miners' electric lamps." H. Wade (Concordia Elektrizitäts Akt. Ges.). August 19th, 1921. (186,781.)
22,559. "Electric burglar-alarm circuits." H. Eisler. August 25th, 1921. (186,787.)
22,680. "Electro-motor controller." W. Fairweather (Singer Manufacturing Co.). August 26th, 1921. (186,789.)
22,704. "Hand electric battery lamp." F. A. Jennings. August 26th, 1921. (186,790.)
23,144. "Electric-current limiting devices." British Thomson-Houston Co., Ltd. (General Electric Co.). August 31st, 1921. (186,797.)
23,320. "Electric sewing machine." W. Fairweather (Singer Manufacturing Co.). September 2nd, 1921. (186,798.)
23,419. "Telephonic systems." E. A. Graham. September 2nd, 1921. (Addition to 7,331/14.) (186,802.)
23,518. "Terminal blocks for electric conductors." A. Kirk and R. C. Milliken. September 3rd, 1921. (186,807.)
24,847. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. October 1st, 1920. (169,698.)
25,428. "Electrical connectors." Credenda Conduits Co., Ltd., and F. F. D. Davidson. September 26th, 1921. (186,826.)
26,561. "Incandescent electric lamps and fans." H. H. Berry. October 7th, 1921. (186,835.)
27,057. "Casings for transformers and other electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). October 12th, 1921. (186,839.)
28,568. "Impulsive driving mechanisms for ignition magnetos." E. A. Watson and M-L Magneto Syndicate, Ltd. October 27th, 1921. (156,868.)
29,752. "Electric fuse carriers and the like." W. T. Henley's Telegraph Works Co., Ltd., and E. Moor. November 8th, 1921. (186,852.)
30,159. "Electrically-heated coffee-making machine." H. Graetz and F. Graetz. November 11th, 1921. (186,853.)
31,517. "Electric incandescent lamps." K. Krausser. December 20th, 1920. (173,218.)

1922.

1,792. "Electron-discharge devices." British Thomson-Houston Co., Ltd. August 29th, 1921. (185,384.)
4,119. "Electrical ignition gear, particularly, though not solely, suited to two-stroke cycle engines." L. H. Hounsfield. February 13th, 1922. (186,870.)
17,053. "Telephone systems." Siemens & Halske Akt. Ges. January 21st, 1921. (Divided application on 174,365.) (182,116.)